nd exten-
(£70,000);
Mile Cross

op, draw-
ection, as
Education;
3, London

modern
Edward W.
ohnstown,

ey Glebe

extension,
.1; chief

epartment
(£48,750);
Hospital

rn school,
architect,

ary class-
te School,
on, educa-

Secondary
Clerey &
, Sunder-

End, and
Park; J. A.

schools
s in Cale-
architect,
ne.

storey to
College;
port, I.W.
chool at
builder,

o); John
on Street,

£26,000);
castle-on-

rpe estate
d., Dogs-

Saviour's
Berkeley

ommercial
ng manu-

k Road

in Malt
ft, Salter

Street;

surveyor,

000) on
Watson,

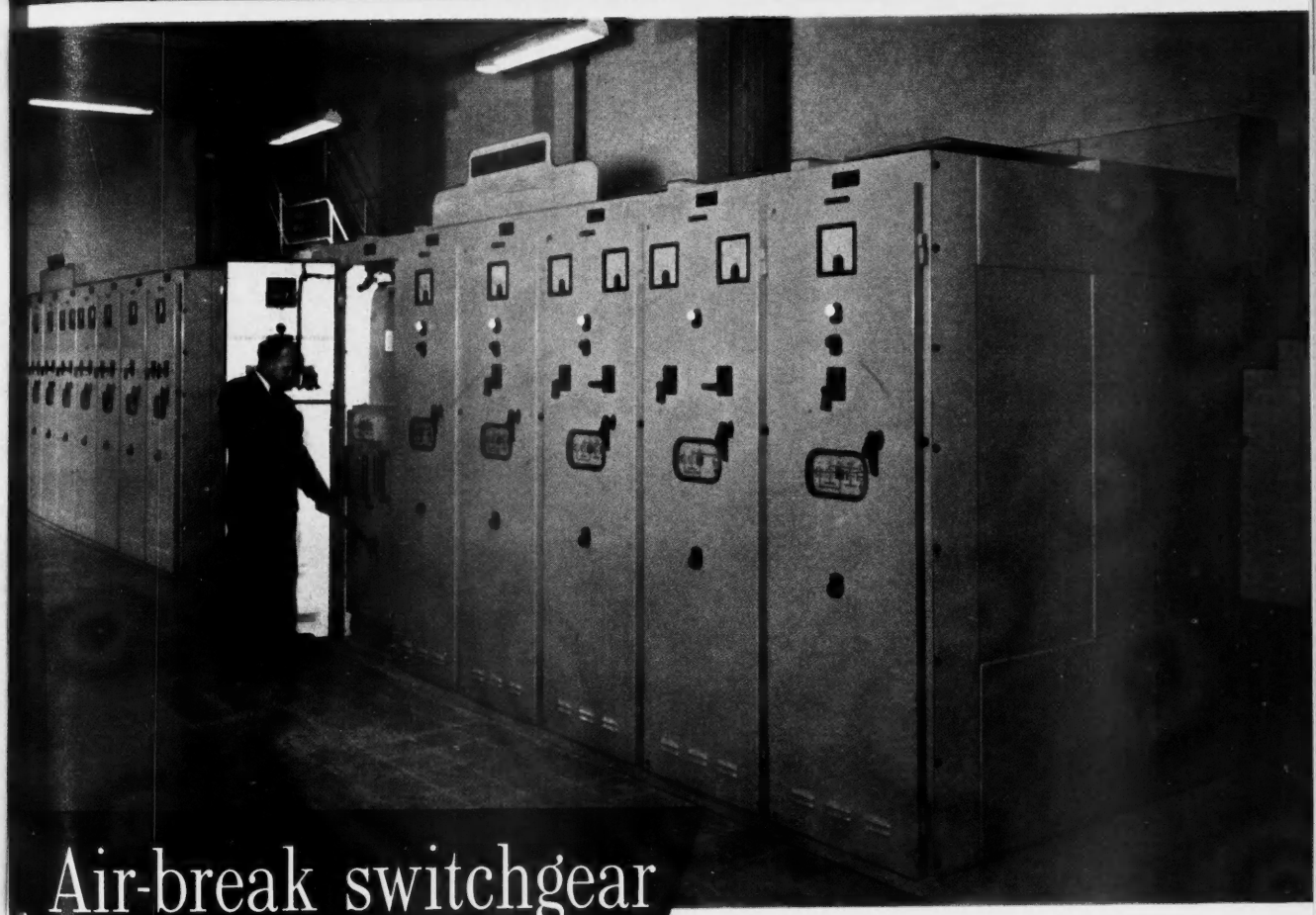
Broadway
er, North

h Shields

borough

Prudhoe
convales-
Regional

ELECTRICAL REVIEW



Air-break switchgear

Two 'ENGLISH ELECTRIC' *Class 'E' 3.3 kV switchboards installed at the Nottingham Power Station of the Central Electricity Authority.*

for power station auxiliaries

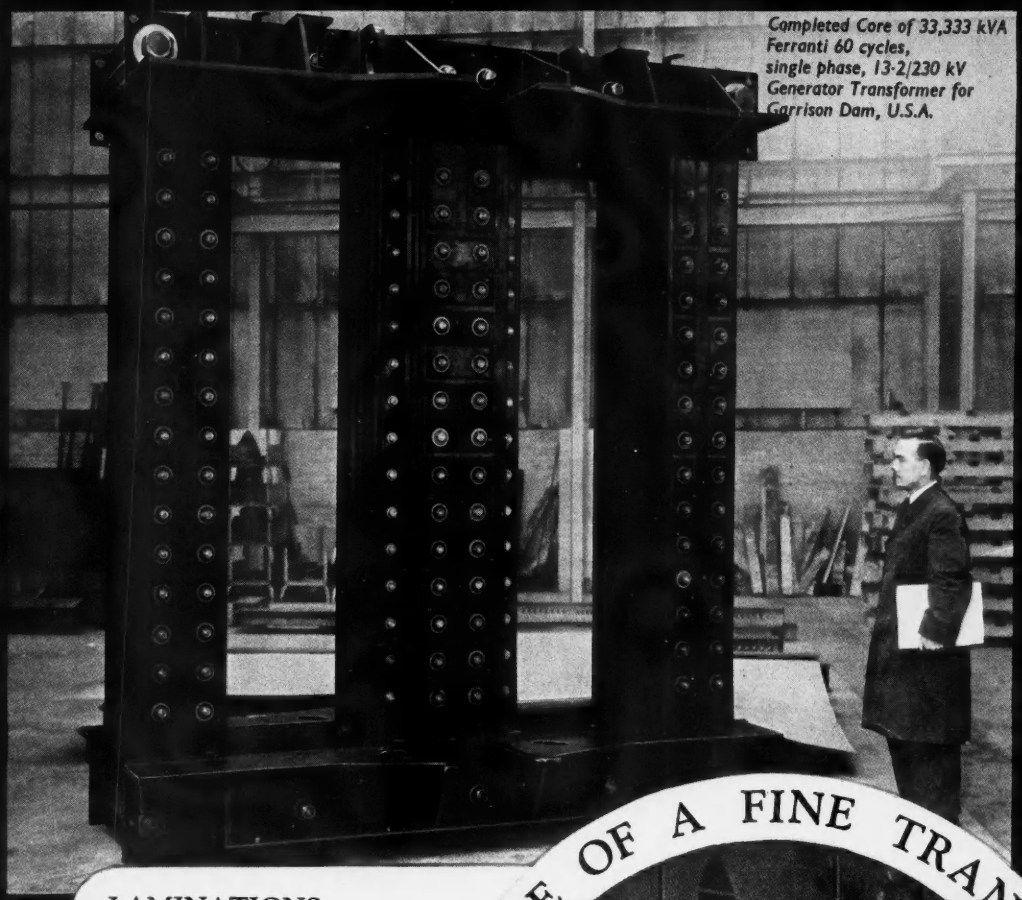
'ENGLISH ELECTRIC'
switchgear

THE ENGLISH ELECTRIC COMPANY LIMITED, QUEENS HOUSE, KINGSWAY, LONDON, W.C.2

Switchgear Department, Liverpool

WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

6E7



Completed Core of 33,333 kVA Ferranti 60 cycles, single phase, 13·2/230 kV Generator Transformer for Garrison Dam, U.S.A.

LAMINATIONS
of all types, in all sizes and in all grades of material.

FERROSIL
hot-rolled and cold-reduced electrical sheet and strip, and hot-rolled transformer sheet.

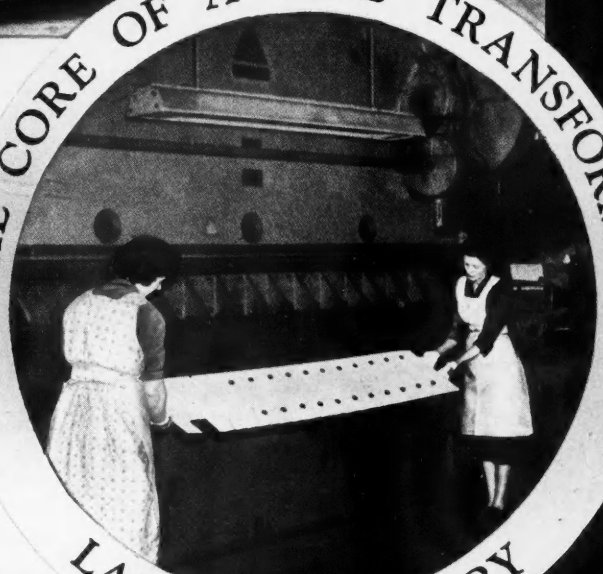
ALPHASIL
cold-reduced oriented transformer sheet and strip.

RICHARD THOMAS & BALDWINS LTD.

LAMINATION WORKS:
Cookley Works, Brierley Hill, Staffs.
MIDLAND SECTION OFFICE:
Wilden, Stourport-on-Severn, Worcs.
HEAD OFFICE:
47 Park Street, London, W.1

Our Cookley Works is one of the largest in Europe specializing in the manufacture of laminations for the electrical industry.

THE CORE OF A FINE TRANSFORMER



LAMINATIONS BY

RTB

24 MAY
1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

In This Issue

Prospects for Aluminium	**941**	Its use in place of copper in the electrical industry
Aluminium in Electrical Engineering	**943**	Report of symposium, arranged by the Aluminium Development Association, which was held at the Institution of Electrical Engineers last week
History of Electric Wiring	**951**	In a book just published Mr. J. Mellanby relates wiring to the historical background of the electrical industry
Hanover Fair	**957**	Among the exhibits at this year's Fair was a comprehensive display by the United Kingdom Atomic Energy Authority
Semi-Conductor Manufacture	**969**	Production at the new Southampton works of Mullard, Ltd.
Teachers for Technical Colleges	**971**	Recommendations of Committee under the chairmanship of Dr. Willis Jackson appointed by the Minister of Education
Domestic Electrical Equipment — Refrigerators	**972**	Illustrated survey of the latest models

✧ ✧ ✧ ✧

Contractors at Llandudno	**952**	**Generation and Development**	**978**
Views on the News	**953**	**New Electrical Equipment**	**980**
Personal and Social	**954**	**Financial Section**	**982**
Letters to the Editor	**959**	**New Patents**	**986**
Industrial News	**960**	**Contract Information**	**987**
Parliamentary Report	**963**	**Next Week's Events**	**988**
Electronics and Automation	**965**		
Transistor Circuits	**967**	*CLASSIFIED ADVERTISEMENTS*	**95**
I.E.E. Annual Report	**968**	*INDEX TO ADVERTISERS*	**108**

VOLUME 160 NUMBER 21 ✧ *Eighty-Fifth Year of Publication* ✧ FRIDAY PRICE 1s 6d

Editorial, Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. **Telegraphic Address:** "Elecrev, Sedist, London." **Code:** ABC. **Telephone No.** Waterloo 3333 (60 lines). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. **Annual Subscription:** Home and Overseas £4 10s 0d; U.S.A. and Canada $14.00. Cheques and Postal Orders (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD. and crossed "Lloyds Bank."

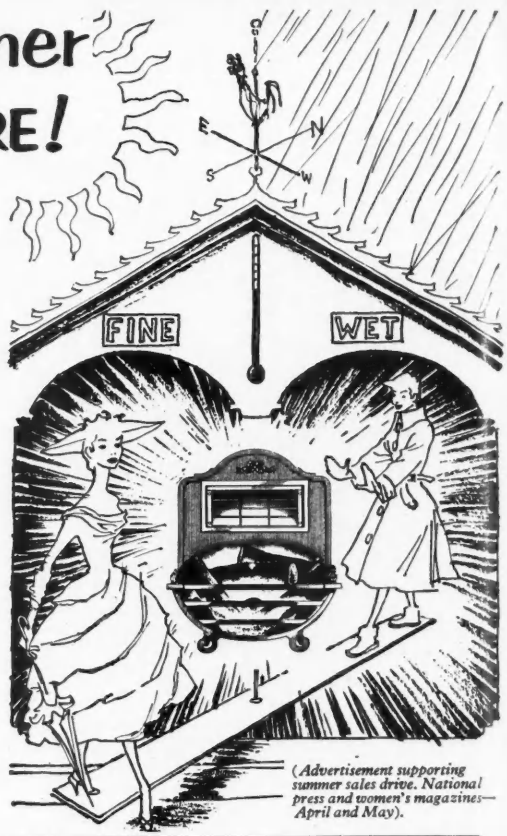
Enjoy your Summer with a MAGICOAL FIRE!

This is the slogan for our Summer Sales Drive. Yes, *Summer!* Our ideas about 'Selling Seasons' have changed since we introduced returnable Warranties. We now know, through daily analysis of the returned cards, that the public are buying steadily throughout the Summer—sales then are as much as 40% of the October peak. Perhaps it is not really so surprising. Even the best Summer has dull days and chilly evenings, and what could be better for these times than a coal or log fire which can be switched on in a second?

If you are one of those who normally put away electric fires as soon as the Winter ends, try an experiment this Summer. Keep two or three Magicoal fires on show and judge for yourself.

Berry's ELECTRIC MAGICOAL LIMITED

Touchbutton House, Newman Street, London W.1 (MUSeum 6800)



(Advertisement supporting summer sales drive. National press and women's magazines—April and May).

SANGAMO TIME SWITCHES

The superiority of Sangamo Time Switches, both in design and performance, has been established over more than twenty years of intensive world service. In addition to 24 hour-dial switches, Solar Dial, Short Interval and Change-over types are also available. Advice and particulars of the entire range of Sangamo synchronous Time Switches will gladly be supplied on application.

SINGLE PHASE AND POLYPHASE WATTHOUR METERS

SYNCHRONOUS TIME SWITCHES

SYNCHRONOUS MOTORS AND MOTOR UNITS

SANGAMO WESTON

PANEL & SWITCHBOARD INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron

PORTABLE INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron, A.C./D.C. Dynamometer

LABORATORY STANDARD INSTRUMENTS
D.C. Moving Coil, A.C./D.C. Dynamometer

CURRENT TRANSFORMERS · FREQUENCY METERS · ALL-PURPOSE TEST SETS AIRCRAFT INSTRUMENTS · RATIOMETERS TACHOMETERS · WESTON STANDARD CELLS · ELECTRICAL THERMOMETERS "PHOTRONIC" PHOTO ELECTRIC CELLS PHOTOMETERS

SANGAMO WESTON LIMITED

ENFIELD · MIDDLESEX

Telephone: ENField 3434 (6 lines) & 1242 (6 lines) Grams: Sanwest, Enfield

Scottish Factory: Port Glasgow, Renfrewshire
Port Glasgow 41151

Branches: London, CHAncery 4971
Glasgow, Central 6208; Manchester, Central 7904
Newcastle upon Tyne, Newcastle 26867
Leeds, Leeds 30867; Liverpool, Central 0230
Wolverhampton, Wolverhampton 21912
Nottingham, Nottingham 42403
Bristol, Bristol 21781
Southampton, So'ton 23328
Brighton, Brighton 28497

ELECTRICAL REVIEW

24 May 1957 Vol. 160 No. 21 Established 1872

Prospects for Aluminium

THE symposium arranged by the Aluminium Development Association last week, a report of which appears in this issue, threw a good deal of light on the merits of aluminium for electrical purposes. Interest was centred mainly on its use as a current conductor, hence inviting comparisons, both technical and economic, with well-established copper. That the papers and discussions raised almost as many questions as they answered was all to the good in turning attention to future prospects of the two metals.

Reports of present achievements were mainly of importance as pointers to potential progress, having regard to the need, always to the fore, of taking into account the rapidity of electrical expansion. First come availability of natural resources, productive capacity and overall price to consumers (including its stability) of the processed ore after allowing for the cost of modifications of workshop practice and other extraneous factors. Production since the war has increased at a far greater rate for aluminium than for copper. What proportion of the difference has been enforced as a result of a temporary shortage of copper and how much will remain owing to the experience gained of any advantages possessed by aluminium remains to be proved.

Data regarding copper resources were given in a lecture by Mr. H. J. Miller to the I.E.E. Utilisation Section reported in our last issue. While alarmist predictions of an approaching exhaustion of copper can be discounted, it may well be asked how much of the world reserves, as in the case of coal, can be made available economically in comparison with so common an ore as bauxite, assuming continuous availability of the requisite large supplies of electricity from nuclear power stations, even should reasonably inexpensive water power fall short of future needs.

Speakers at the conference were in general agreement that aluminium has secured premier place for overhead lines and also, less clearly, for insulated cables now that early difficulties in jointing (at one time regarded as almost insuperable) are being overcome. For windings of generators, motors and transformers the balance seems more even, with a tendency for the time being to prefer copper. There appears to be, however, an ultimate probability of the construction of electrical machinery outstripping the ability of the copper industry to meet the calls on its productive capacity, thus accelerating a swing in favour of aluminium. One need not accept the view expressed that only an ultra-conservative outlook has prevented a much wider substitution of aluminium for copper in order to appreciate the value of aluminium in taking over from copper the function of meeting incremental electrical requirements, thus possibly leaving the annual amount of copper used at a figure not much different from the present one.

TECHNICAL TEACHERS

Forty-six recommendations for improving the supply and training of technical college teachers are given in the report of a special committee set up by the Minister of Education last year, under the chairmanship of Dr. Willis Jackson. ("The Supply and Training of Teachers for Technical Colleges," H.M. Stationery Office, 4s net, a summary of which appears on page 971.) The achievement of the Government's five-year plan to double the present number of technologists and technicians will require 7,000 more full-time teachers in technical colleges and 8,000 more part-time teachers by 1960-61.

One of the Committee's main recommendations is that industry's contribution to the provision of technical teachers must be much greater. It must be willing to accept, encourage and assist the transfer to full-time teaching work of experienced staff members it can ill afford to lose, as the only means of ensuring a much augmented supply of junior recruits of high quality. The Committee says that it must become commonplace for individuals to move from industrial to teaching employment, and vice versa, or be fully recognised members of both at the same time. For some years industry must be prepared to lose more than it may appear to gain. Unless employers are prepared to arrange on a greatly increased scale for suitable members of their staff to teach part-time during the day, the technical colleges may find it impossible to make the educational provision which industry will require.

NUCLEAR ENERGY CONFERENCE

When the British Nuclear Energy Conference was formed in 1955 it was announced that the new organisation would be representative of the Institutions of Civil, Mechanical, Electrical and Chemical Engineers and the Institute of Physics. It was later decided to admit to membership the Iron and Steel Institute and the Institute of Metals, as reported in our issue of 18th January.

If the statement associated with the announcement of the constitution of the B.N.E.C. was correct, that it was formed to provide a common ground, in the light of recent rapid developments in the technology of nuclear energy, between scientists and engineers where these developments could be discussed, then we are sure that the inclusion of these two Institutes is a sound decision. When the Conference was established opinion was well divided on the question of whether or not there should be a new and separate nuclear energy institution with a status in line with that of the other learned societies. This is still to some extent unsettled because if the future shows that nuclear energy has carried out its promise then it may be considered that there should be one over-riding "Power Institution" with all the other Institutions, including one for nuclear energy, as specialised sections, in much the same way as the specialised sections of the Institution of Electrical Engineers exist at present. On the whole, however, we would not like to see the present arrangement disrupted because it appears to be working so well.

E.C.A. CONFERENCE

Next week's *Electrical Review* will contain an illustrated report of the proceedings at the annual conference of the Electrical Contractors' Association being held at Llandudno from 26th to 28th May.

TRANSISTOR DEVELOPMENTS

There is always a considerable time lag between the invention of a device and its large-scale manufacture and application. But perhaps because of its undoubted value for a wide range of applications, particularly those involving military equipment where low weight is an essential requirement, progress in transistors has been rather more rapid than is usually the case. A good example of the sort of development which is taking place is in the new Mullard factory, Southampton, which is described in this issue and, when complete, will be the largest single mass-production unit for semiconductors.

Parallel with the development of manufacturing techniques, transistor circuit technology has been the subject of intensive programmes of research, particularly during the last two or three years. A major factor in the progress which has been achieved of late has been the general availability of transistors of acceptable performance characteristics and reliability. This is probably because the point-contact type of construction has been superseded by units of the alloyed- or grown-junction types.

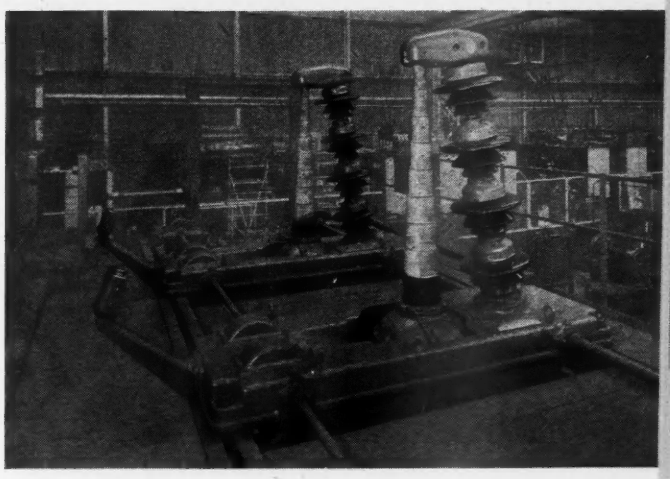
As regards reliability, only a limited amount of work has so far been done in connection with transistors but in an I.E.E. paper reviewed in this issue, Dr. A. G. Milnes states that very encouraging results have been obtained, for instance, in digital computer and telephone systems, which are comparable with the results obtained with premium grade thermionic valves developed for high reliability.

FUTURE OF THE B.I.F.

It is accepted form to describe each successive British Industries Fair as successful, although the degree of success has varied over the years and the method of measurement has always been uncertain. This year's Fair may have benefited, as a solely Birmingham affair, from the closing of the London sections, but it must have suffered from the reduction of overseas publicity which followed the cessation of the Government grant for the purpose. The support of the electrical industry was drastically reduced even from the low level reached in 1955. (In 1956 the move to London brought in more electrical concerns.) It is quite clear that the Electrical Engineers' Exhibition has taken the place of the former B.I.F. Electrical Section.

Some supporters of the Fair consider that it should be "internationalised" but, although the organisers have plenty of space, it is doubtful whether the greater attractions of the established Continental fairs could easily be matched or whether Birmingham is not too "remote." A site nearer London might have greater possibilities. What is happening about the Crystal Palace proposals?

ALUMINIUM IN ELECTRICAL ENGINEERING



SYMPOSIUM ON ECONOMIC AND TECHNICAL TRENDS

AT a symposium arranged by the Aluminium Development Association, which was held on 16th and 17th May at the Institution of Electrical Engineers, twelve papers on the use of aluminium in electrical engineering were discussed. In the opening session, dealing with general and economic considerations, Dr. E. G. West (technical director of the Association) compared the production, use, present economics and trends of aluminium, copper, lead and zinc during recent years. Production of aluminium, which had been of commercial significance for only 70 years, was, he said, doubling every decade. Between 1930 and 1953 its increase of 300 per cent compared with 160 per cent for electricity generation and 25 per cent for copper.

Abundant Supplies

Aluminium was the most plentiful metal in the earth's crust, of which it formed 8 per cent by weight. It was normally obtained by chemical extraction from bauxite (the known world reserves of which exceeded 2,000 million tons). Economical production was usually limited at present to ores containing over 50 per cent alumina, the oxide being then reduced to metal in electrolytic cells with a consumption of about 20,000 kWh/ton which accounted for 12 to 15 per cent of the cost of the finished metal. An investment of £1 million was needed for each 1,000 tons per annum. In Great Britain productive capacity was limited to 30,000 tons per annum (from Scottish hydro-electric power), whereas consumption last year at 350,000 tons per annum (24,000 tons for electrical purposes) was the highest of any country except the U.S.A. Over 220,000 tons of virgin metal was imported yearly from Canada by the British fabricating industries.

One ton of the metal might require the movement of four to six tons of bauxite to produce two tons of alumina, from which one ton of metal was obtained; with the addition of other materials the total transported reached eight to ten tons. After smelting the purity was 99 to 99·8 per cent and the metal required no further refining for electrical purposes.

The title picture shows an indoor 132 kV isolator having its main base, blade support and corona shield made of aluminium alloy castings

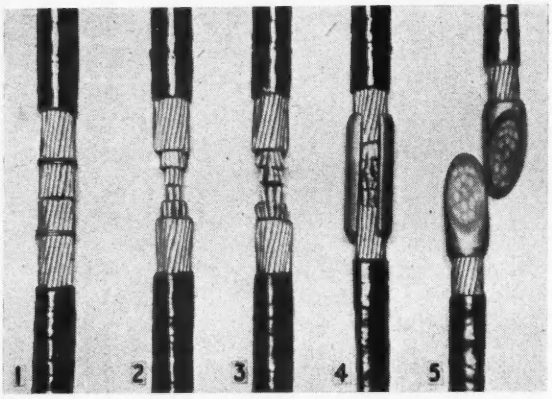
When evaluating the relative costs of aluminium and copper as conductors having equal resistance, account had to be taken of their different weights because metal prices were always quoted by weight. Copper weighed three times as much as aluminium, which had 1·6 times the volume for equal electrical resistance. In a typical case of stranded overhead conductors of 0·1 sq in copper equivalent, costs per mile based on prices of copper at £240/ton and aluminium at £197/ton were: copper, £293; all aluminium, £144; steel-cored aluminium, £162; aluminium alloy, £204.

For short lengths of conductor, aluminium would carry 10 per cent more current than copper. In the case of insulated cables, the saving would be somewhat offset by the increased cost of insulation, since the diameter of the aluminium conductor was 1·25 times that of copper of equal resistance. Other properties of aluminium influencing its economic use included good corrosion resistance, and with the application of special surface treatments, such as anodic oxidation, it is able to withstand severe conditions.

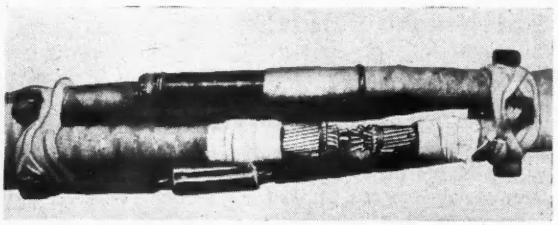
The long-term supply of aluminium and its price stability were superior to those of the other non-ferrous metals concerned. For certain applications copper might remain the most suitable conductor material, but the rate of increase in generating plant capacity was exceeding that of copper output. Similar considerations applied with even more force to substitution of aluminium for lead in cable sheathing.

Properties of Electrical Interest

Tabulated comparisons between aluminium and its alternatives were set out in a paper by Messrs. C. H. E. Ridpath (Aluminium Wire & Cable Co.) and D. F. J. Worth (A.D.A.), who also particularised the relevant British Standards and referred to other physical properties of aluminium of electrical interest. These included: affinity for oxygen, as shown by the oxide film (5×10^{-7}in thick) which formed immediately on exposure to air; bimetallic corrosion through contact with copper and its alloys and, to a much lesser extent, mild steel in marine and industrial atmospheres, protection from which was obtainable by using magnesium sacrificial anodes; and



Five stages in the production of a straight-through joint: **1.** *Conductors stripped of insulation.* **2.** *Conductors stepped.* **3.** *Conductors barbed and tinned.* **4.** *Conductors with ferrule in position (but not closed).* **5.** *Completed joint (sectioned)*



Straight-through joint on 0·2 sq in four-core cable, showing conductors at different stages of completion

low magnetic susceptibility with consequent elimination of hysteresis losses.

On the subject of jointing Messrs. J. C. Bailey (A.D.A.) and P. Gregory (British Insulated Callender's Cables) based their approach on processes that were applied to aluminium in non-electrical fields. These, having been designed to match the special characteristics of aluminium, would be more suitable than some modified version of processes initially developed for jointing copper with its different melting point and electrical resistivity. As a result the authors concluded that aluminium could be jointed at least as readily as copper and that aluminium sheaths were as readily jointed as lead sheaths.

A major difference between the two metals lay in the nature of their oxide films and the rate of their re-formation after surface cleaning. The aluminium oxide film, adherent and non-conducting, re-appeared immediately; the semi-conducting copper-oxide film was built up more gradually. Immediate application of moisture-free petroleum jelly in either case largely prevented film growth.

Aluminium oxide films were attacked by fluorides and chlorides, which were therefore used in welding or soldering fluxes, and were dissolved by caustic alkalis. The process appeared to be largely mechanical and might be the reason why anodised aluminium surfaces could readily be jointed by cold pressure welding, which suggested new methods of attacking the problem. Brazing was equally suitable and bolting, clamping and soldering, as used with copper, could be successfully modified for aluminium. The relatively low melting point of aluminium and its high specific heat favoured fusion welding, while the increased resistivity over that of copper favoured resistance welding.

The application of aluminium and its alloys to the grid was described by Mr. G. B. Jackson (Central Electricity Authority) under the headings of transmission-line supports, conductors and conductor accessories. An example of the first was the top structure of a tower erected in 1954 for a double-circuit 132 kV line near Birmingham. The aluminium-alloy portion, extending to 16ft below the bottom cross arm, weighed 2,055 lb compared with 4,100 lb for mild steel. It remained to be seen whether this trial tower top would withstand corrosion in industrial atmospheres.

For galvanised-steel-cored aluminium conductors three standard sizes of stranding were now employed. At 132 kV the line conductors were 37/·110in and 61/·125in and earth conductors were 19/·110in and 37/·110in for ratings of 90 and 145 MW respectively. At 275 kV the same pair of line conductor sizes in twin-bundle arrangement, rated at 375 and 575 MW, were adopted, but the earth conductor was 37/·110in in both instances. Long spans, usually when crossing rivers, were strung with s.c.a. conductors except at Dagenham (Thames), but the requirement to give a traffic clearance of 200 to 250ft with spans exceeding 3,000 to 4,000ft, such as those of the Forth and Severn crossings, necessitated the use of special conductors owing to the excessive tower height required.

Experimental Transmission Lines

Two experimental 37/·110in conductors were at present undergoing trials in a 132 kV line near the coast. In one an extended aluminium sheath replaced the outer layer of strands and in the other it replaced the inner layer. The latter was found more flexible in handling, but the external type seemed superior in resistance to corrosion and vibration effects. In general, corrosion in industrial atmospheres attacked the outside surface overall and pitted the internal aluminium strands, whereas coastal corrosion was mainly due to electrolytic action between the steel core and inner aluminium strands. In such areas in Great Britain the loss of mechanical strength of the complete conductor averaged 0·4 to 0·5 per cent per annum, corresponding to a service life of 25 to 30 years. Special greases had proved effective in combating corrosion.

That aluminium could be satisfactorily substituted for copper for overhead distribution lines up to 33 kV on wood poles was the experience of Messrs. R. Cloke and R. Fyfe (Eastern Electricity Board). For low-voltage lines all-aluminium conductors had proved the most suitable. Availability on the British market of a reasonably priced hand-operated hydraulic compression tool of small dimensions and low weight would add to the merits of aluminium. For high-voltage lines to B.S. 1320 construction s.c.a. was cheaper, but a homogeneous alloy conductor had advantages which seemed to make it the better overall choice. Steel-cored aluminium was usually most suitable for heavier high-voltage lines, in which compression fittings were necessary for long-term satisfaction. Where very high tensile strength was required, as in replacement of existing steel conductors, steel-cored high tensile aluminium was found economical and greatly increased current-carrying capacity.

Distribution Cables

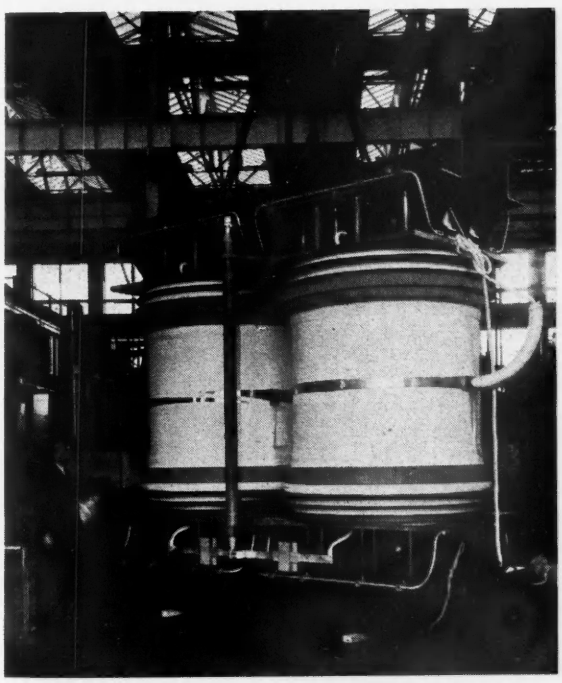
Another paper concerning distribution by an Electricity Board was prepared by Mr. G. F. Peirson (Midlands E.B.), who recounted the economic considerations which led to the adoption in 1955 of aluminium for medium- and low-voltage insulated cables. Taking prices of aluminium at £165 and of copper at £250 to £400, the

possible saving ranged from 4 to 22 per cent and original plans to employ copper were changed. Copper-equivalent sizes did not generally give the best practical designs and existing standard sizes for copper of 0·06 up to 0·3 sq in were retained in four-core cables. This necessitated redesign of networks to give the same voltage drop. Little financial advantage was shown by aluminium of 0·0225 sq in, for which copper was still used.

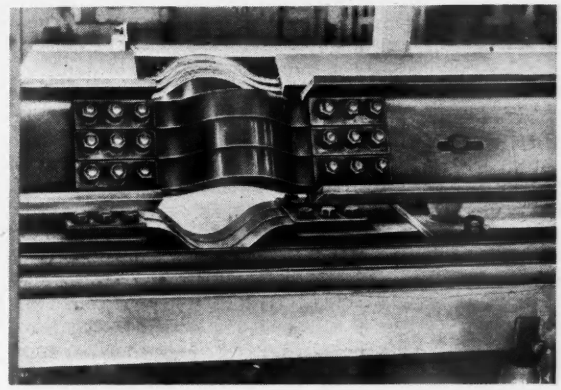
In jointing, soft-soldering methods were the most practical, the chief difficulty being the self-oxidising of the aluminium. Conductors of straight-through joints were stepped and barbed for effective tinning of each strand, during which scrubbing by nylon brushes assisted removal of oxide films. Tin-lead-solder was standardised as metal and flux, the relatively low temperature of which reduced risk of charring of paper insulation. Probably, however, a mechanical compression joint developed by the Midlands E.B. for overhead aluminium conductors would displace soldering as at present used for underground cables. During the financial year 1955-56 savings from the use of aluminium reached £170,000, with satisfactory performance of cables and joints.

Transformer Construction

Aluminium for transformers provided the subject of a paper by Messrs. F. W. Gee and R. J. Gresley (Ferranti, Ltd.), who pointed out that, in addition to the comparative costs of aluminium and copper, the cost of core steel and transformer losses had to be taken into account. For example, conductors of 0·1in by 2in with 0·015in paper covering cost in pence/lb in August, 1956, 46·5 for copper and 53·5 for aluminium. The latter for equal resistance would have a 50 per cent greater cross-section, entailing a heavier and bigger core made of a more expensive grade of steel to maintain the same no-load loss. Increasing use of costly cold-reduced grain-oriented instead of hot-rolled steel had offset the increasing price ratio of copper to aluminium.



Core and aluminium windings of a single-phase unit of 213 MVA 300/13 kV three-phase transformer



Flexible joint in trefoil busbars (G.E.C.) in an electrical works

In general, any advantage of one conductor metal over the other was likely to be marginal, copper winning for high-efficiency designs, i.e. when the capitalised values of the losses were high. The drawback of the greater bulk of an aluminium winding might in the future be largely countered by thickening the oxide film by electrolytic anodising. The anodic film of only 0·0002 to 0·0004in had good insulating properties and improved the conductor space factor to nearly unity.

Several methods of jointing had been found satisfactory as follows: Enthoven A20 solder for winding joints on small transformers; resistance-butt or flash-butt welding for strands within a winding; clamped connections to busbars, but only with safeguards against the effects of cold flow of the aluminium by the use of spring washers; and argon-arc welding for larger joints. Aluminium had been used for transformer tanks with a typical reduction in weight to one-half, but the cost was 75 per cent more and was justifiable only when the reduction in total weight avoided costly dismantling. This consideration applied also to coil-clamping structures, although sometimes the non-magnetic properties of aluminium lessened stray losses, making it preferable to steel, or its corrosion resistance saved the cost of painting small tanks.

Aluminium Alloy Busbars

While the recent introduction of aluminium alloys with substantially improved mechanical properties had largely removed one obstacle to more extensive use for busbars, jointing was still widely regarded as a bogey. That this need not be so was shown by Mr. A. R. Parish (English Electric Co.), who described varied load-cycle and short-circuit tests on aluminium, both electrically pure and alloyed, and on copper. These indicated a substantial economic advantage from aluminium that was unaccompanied by any serious difficulties. Important factors in successful jointing were scratch brushing under grease and by using a British proprietary compound.

Electrically pure aluminium had 61 per cent of the conductivity of copper, and for the same section would carry 79 per cent of the current; this entailed an increase of about 25 per cent in width or of 50 per cent in thickness of flat bars. If this necessitated changes in other parts, the economic advantage of aluminium might disappear. It seemed improbable that it would be used for busbars in metalclad switchgear, in view of the increased size and cost of enclosing castings.

Alloys containing small quantities of magnesium and silicon, which increased tensile strength by 160 per cent at a cost of 8 per cent reduction in conductivity, were attractive for channel and angle sections. Thermal

expansion of aluminium, pure or alloyed, was 40 per cent more than that of copper.

The most important future contribution of aluminium to telecommunications was envisaged by Messrs. R. C. Mildner and B. F. Thorne (Telegraph Construction & Maintenance Co.) as being in subscribers' distribution and other local cables, where protected from corrosion and where jointing problems had been solved in practice. For broadband carrier telephony over air-spaced coaxial cable it was unlikely to be attractive as a sheathing material until a simple non-mechanical joint and completely effective means of prevention of corrosion had been developed. In such specialised fields as radio and television feeders and high-power transmitters it would remain important, largely as sheathing of cables, and in some abnormal situations, perhaps as a centre conductor.

Efficiency of transmission at high frequencies tended to be proportional to resistivity, but this was offset by the higher cost of insulation, especially plastic, required for the larger conductors. Aluminium for sheaths had one outstanding advantage over lead in ability to withstand severe vibration. Protective coverings were recommended for all sheaths above ground to avoid pin-holing. There was urgent need for a light and inexpensive covering, preferably applied simultaneously with tube extrusion and unimpaired by the sinking process. Maximum use of aluminium would be achieved only when direct extrusion over the cable core was feasible. Aluminium tape was sometimes employed for screening between the conductors and electric and magnetic fields outside the cable. Owing to the superior hardness and toughness of aluminium over lead sheaths, armouring could often be dispensed with. A lightweight armourless submarine coaxial solid-polythene-insulated cable under development by the British Post Office had an aluminium return conductor in the form of long-lay helical tapes 0·015in thick. Aluminium jointing and loading coil cases had been designed by the authors' company and by the Sterling Cable Co. to take either conventional plastic telephone cables or cables containing aluminium.

Aluminium in the Telephone Service

In a review of the main uses of aluminium in the British telephone service, Messrs. J. Gerrard and T. P. A. Urben (G.P.O.) said that it showed little advantage in overall cost for small-gauge-conductor cables for subscribers' circuits. In heavier trunk or junction cables it might be economical, in spite of the greater duct space demanded. It showed promise for sheaths screening cables against interference. In construction of equipment aluminium was extensively used for die-cast frames of complex form. The largest quantity of aluminium used was in spacing segments of contact assemblies, where the ability of the metal to flow under pressure enabled dimensional differences in contact and insulating segments to be accommodated.

A typical cable from a large telephone exchange contained 1,800 pairs of 0·016in diameter copper conductors. For the same resistance limits the diameter of aluminium conductors would be 0·02in in 1,400 pairs, thus increasing the number of expensive conduits required. A second major factor was that, whereas with copper dry twist joints were standard, aluminium conductors must be soldered or welded. Technically, that presented no difficulty, but time was taken by the additional operation on a cable that might include 1,000 joints.

In the sheath of a 2in diameter cable, lead weighed 6·7 tons/mile and aluminium 1·6 tons, costing £780 and £320. After allowing for the higher cost of the aluminium sheathing process, the advantage was in its favour. The better screening factor afforded by an aluminium sheath (up to seven times as good as lead) was of growing importance in keeping induced voltage from 50 c/s power systems within agreed limits and lessening the risk of interference.

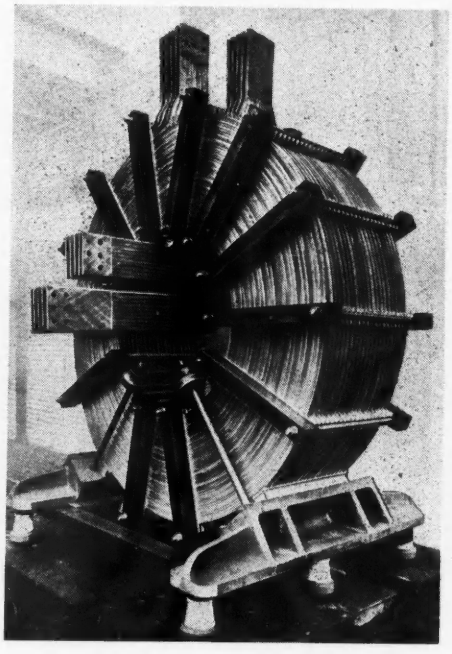
Overseas Experience

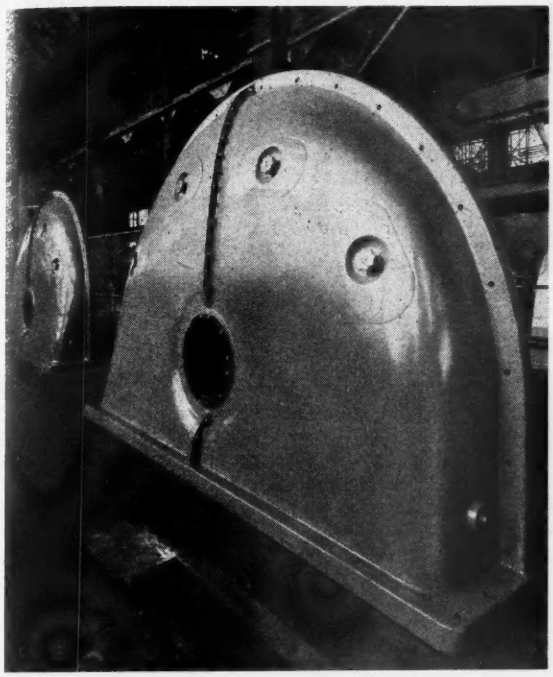
Two final papers dealt with French and German experience. Mr. P. Jacomet (Aluminium Français) recorded that since 1947 the price of copper had increased more rapidly than that of aluminium. Last January, the replacement of 2 kg of bare copper by 1 kg of aluminium effected a saving in cost of 63 per cent as against 13 per cent in 1938. The author's conclusion was that aluminium was suitable for field windings and interpoles (but not for commutators and armatures) of d.c. machines and for stator and rotor windings of alternators.

Motors must be especially designed for aluminium windings to achieve the same efficiency as with copper and the larger core slots increased significantly the overall dimensions of a motor. Small aluminium squirrel-cage rotors, made by centrifugal or die casting, were, however, becoming popular. Comparisons between transformers of 500 and 2,000 kVA showed that for the same loss characteristics in the iron and coils the two wound with aluminium were heavier but lower in price. Anodised aluminium conductors were found to be of particular advantage for windings of electro-magnets and for coils operated under arduous conditions of pressure and temperature and where low weight was required.

In Germany, Mr. W. von Zwehl (Aluminium-Zentrale, Dusseldorf) reported, electrical uses accounted (in 1955) for about 16 per cent of the total consumption of aluminium. On the 400 kV grid, four s.c.a. conductors were used per phase, but no compression joints. For cables at all distribution voltages aluminium was widely

Annealed aluminium (99·5 per cent) windings of 20,000 A 380 V reactor. The windings are made up of 100 flat strips, each 20 by 16 mm arranged in layers of ten strips, which are gas welded to the aluminium terminating strips (200 by 15 mm). Coil: exterior diameter, 1·80 metres; thickness, 0·51 metre; interior diameter, 0·85 metre; weight of windings, 2,000 kg





Cast aluminium end-shield for large generator

used for conductors and sheathing. The direct endless extrusion method of sheathing was regarded as likely to predominate in the future.

In low-voltage networks the aluminium sheath was used as the neutral, halving the cable cost compared with that of a cable with four copper conductors and lead sheath. A British proprietary jointing compound recently developed was expected to provide an efficient and practical improvement for bolted joints of busbars. The high insulation resistance of anodic film had favoured the choice of aluminium for lifting magnet windings and brake coils. Service experience had shown the behaviour of normally insulated aluminium (introduced on account of copper shortage) to be equal to that of copper in the windings of motors and transformers.

DISCUSSION

The discussion at the first session, over which Mr. G. W. Lacey presided, was opened by Mr. P. M. Hollingsworth (British Insulated Callender's Cables) who said that for conductors the price of aluminium must be attractive; otherwise it would not replace copper. For sheathing, aluminium gave a decided technical engineering advantage for pressure cables and its use was likely to extend considerably with increased demand for electricity.

Mr. F. W. Gee (Ferranti) emphasised the importance of combining jointing technique with routine testing of every joint so as to sort out any bad joints.

Mr. H. B. Grainger (I.C.I) described the development of a chemical jointing compound which offered the electrical industry a simple and reliable method of producing low resistance joints in busbar installations.

Mr. L. G. Hill (Vickers Armstrong (Aircraft)) commented on some unhappy experiences with hexagonal crimp in aluminium cables and suggested means of overcoming the problem.

Mr. C. R. Vassel (Hungarian Research Institution of Non-Ferrous Metals) said that owing to the difficulty of obtaining copper in Hungary, aluminium had been used to a considerable extent in its place and had proved satisfactory for both conductors and sheathing.

Mr. J. H. R. Nixon (Brush Electrical Engineering Co.) said that, if only as an insurance against the possibility of copper not being available in sufficient quantities, the electrical engineering industry was anxious to collaborate closely in studying the use of aluminium. Among factors retarding its use were the multiplicity of solder alloys, which made a choice of a suitable one difficult, and the bulk of aluminium.

Mr. P. A. Raine (Johnson & Phillips) regretted that as the paper on jointing was confined to fundamentals it was almost immune from criticism but he would have liked more attention to have been paid to the pros and cons of individual methods, though this would have introduced controversy.

Mr. Barford (Aluminium Laboratories, Banbury) stressed that there was no corrosion unless there was something to start it. With a dry joint there was no corrosion.

Mr. F. L. French (Aluminium Union) said that 420,000 tons of aluminium was used in countries where data were available as compared with over three million tons of copper, about 28 per cent of the weight of copper used. Regarding the long-term stability of metallic powder and greases on joints a definite opinion could not yet be expressed, but tests on bolted connectors containing metallic particles had not shown apparent deterioration of resistance.

Busbar Bolted Joints

Mr. Rouillier (Aluminium Union) thought an oxide film on aluminium had little effect on the electrical efficiency of busbar bolted joints. He described the "coherer effect" produced when currents were passed through areas surrounding points of metal contact which broke down the oxide film. For improving joint efficiency he recommended scratch brushing in petroleum jelly; he had seen examples of this in Germany, where not a single breakdown had occurred.

Mr. G. A. Durrance (General Electric Co.) said that his own experience was that grease or petroleum jelly was effective for only a limited period.

Mr. L. G. Donelan (General Electric Co.) agreed that cold pressure welding offered considerable scope in jointing.

Mr. C. T. Marx (Erma, Ltd.) said that hexagonal crimp had been used for many years with success in this country and in the United States. Aircraft service imposed most stringent requirements on equipment and components. Joints were not usually the original cause of any failures.

Mr. B. West (Westinghouse Brake & Signal Co.) was not sure whether high-current applications were assisted by the coherer effect. Bolted connections were successfully used without previous preparation of the bars.

Mr. R. F. Bloodworth (Air Registration Board) pointed out that weight rather than economy had tended to make aluminium attractive in aircraft electrical engineering. The hexagonal crimp had been satisfactory in industry in general and possibly any failures were in the bolted connection.

Mr. Greer (Dublin) described the Properzi method of producing aluminium wire, which he considered as suitable for use in smaller countries owing to its relative cheapness.

Dr. Jenkin (General Electric Research Laboratories) emphasised the need for the aluminium industry to bear in mind the high standards and traditions of its predecessor, copper.

Transmission and distribution lines formed the subject

of the second session, over which Dr. H. G. Taylor (E.R.A.) presided, when Mr. W. J. Nicholls introduced three papers.

Mr. P. A. Raine (Johnson & Phillips), opening the discussion, suggested that soldering by inorganic reaction fluxes, for which metal composition was less critical, should have been more carefully considered by Mr. Peirson, in view of their long record of success on the Continent. The use of reaction flux called for no elaborate training or equipment.

Mr. C. T. Marx (Erma) suggested that the best method, technically and practically, of connecting aluminium conductors was by compression. Tools for jointing insulated aluminium conductors underground were becoming available in conjunction with which cable compression joints were being designed to meet the most stringent requirements of mechanical strength and electrical conductivity for use in standard junction boxes and equipment. Apart from the larger diameter of the ferrules, the newly designed joints were neat and eliminated manipulation of molten metal, the open flame and obnoxious fumes. Jointing difficulties would not limit the success of any aluminium project.

Comparative Costs

Mr. L. A. Bates (North Eastern Electricity Board), comparing two cases of 0·05 sq in and 0·1 sq in copper-equivalent conductors (copper at £250/ton and aluminium at £195/ton), said he had found the cost per mile of a three-phase line, with the supply and erection of the conductor and fittings, to be £610 for copper and £480 for aluminium, giving an initial saving of 21 per cent. Interest and depreciation to cover renewal of conductor and line was £27 per mile for copper and £24 per mile for aluminium. For 0·1 sq in copper equivalent, the initial saving was 27 per cent and the long-term saving 17 per cent. These figures did not take into account probable higher costs of poles and insulation with s.c.a. conductors or the higher scrap value of copper. The Board's policy was to continue the use of aluminium conductor cables for low- and medium-voltage distribution so as to establish a satisfactory jointing technique throughout the area which would allow the use of either copper or aluminium as circumstances might dictate.

Mr. D. McAllister (B.I.C.C.) emphasised that the cable makers were satisfied that the savings obtainable with aluminium were not at the expense of operating performance. So far, the disadvantages of other methods of jointing than soft solder had appeared to outweigh the advantages. Welding methods were tedious and with reaction fluxes there was the problem of flux residues. The most promising alternative seemed to be compression jointing, for which development work was proceeding steadily if a little slowly. In the meantime, they were seeking to improve the organic flux soft-soldering method.

Mr. W. Gibbon (B.I.C.C.) described work on the design of compression tools for jointing multi-core cables, which had culminated in the design of a 10-ton capacity tool for making both straight and tee joints. The straight two-piece ferrule had overcome conductor bowing and distortion experienced with the conventional one-piece ferrules. Straight joints and terminal lugs for cables up to and including 0·3 sq in and also tee joints for main cables up to 0·3 sq in and branch cables up to 0·1 sq in were now available for field trials.

A speaker from Russia said that in the U.S.S.R. aluminium was widely used in transmission lines as well as in switchgear at all voltages. All transmission lines were now made of steel-cored aluminium or of aluminium alone, except near sea-shores, where copper was used. Since 1945 insulated conductors of 25 sq mm and above had found widespread application indoors; they could be used in all factories, explosive atmospheres and coal mines excepted. They were also used in all circuits with the exception of measuring and control circuits at power stations with a capacity of 5,000 kW and above. Low- and high-voltage cables up to 10 kV with aluminium cores had found wide application but not so extensive as that of other conductors and bars. Aluminium sheaths instead of lead were not used on such a large scale. Experience of aluminium bars, conductors and cables confirmed the possibility of their wide application.

Mr. D. W. Vaughan (Central Research Laboratories) said that experiments were being conducted with trolley-mounted gauges to detect bulges in conductors due to electrolytic corrosion.

Mr. Nuttall (Balfour, Beatty) emphasised the possibility of using aluminium structurally. Because of inability to get steel towers from this country, his firm had been obliged to use Continental steel in work abroad. Experimental work on tubular structures might be profitable, but these would not reduce the weight of a tower by 50 per cent.

Mr. MacDonald (Merz & McLellan) said that the North of Scotland Hydro-Electric Board had used aluminium and alloy conductors extensively. Up to the end of last month, 3,600 conductor miles of alloy and plain aluminium had been erected, representing about 1,400 route miles.

Mr. J. Prest (C.E.A.) pointed out that a carbon-steel tower required painting after five years when erected in a polluted atmosphere. A grease coating would also require some maintenance when put on a galvanised steel core.

Mr. W. G. Cunnington (Midlands Electricity Board) referred to the statement of Messrs. Cloke and Fyfe that the use of compression connectors on low- and medium-voltage lines of the Midlands Board was limited to dead-line application. In fact, the Board were applying all connections on that class of line, live or dead, using compression type connectors and an appropriate compression tool. Hard rubber sleeves were used to shield the conductors which were not being connected.

Mr. J. Staley (U.S.A.) said that about 97 per cent of all transmission line conductors in the U.S.A. were of aluminium and about 70 per cent of all covered cable. In time, all steel reinforcement in aluminium cable would be aluminium dipped or coated. In general, the performance had been better than with galvanised steel.

Mr. A. J. Gibbons (C.E.A.) emphasised the technical problems involved in the use of aluminium conductors in large high-voltage substations. Much development work was inevitable on the many clamps and fittings; each variety of plant must be tested for electrical and mechanical performance. There was a natural reluctance to embark on a major experiment unless most of the expected troubles had been ironed out in advance.

Cable Sheathing

The third session related to electrical equipment. The chairman was Mr. Harold Goodwin (Birmetals) and the rapporteur was Mr. Arnold Gregory (Northern Aluminium Co.). Before the discussion, a further paper, relating to experience in North America, was presented by Mr. J. Staley (U.S.A.).

In the discussion, Mr. K. H. Hahne (Osnabrucker Kupfer) expressed the opinion that the special extrusion presses developed in the United Kingdom and in Germany would be the final solution for applying aluminium sheathing to cables. The drawing-in method and the welding method he regarded as mere intermediary stages

which would be surpassed by direct extrusion in respect of both costs and safety. There would always be competition between aluminium and lead and other cheaper materials, such as iron sheet, which necessitated the reduction of wall thicknesses to the minimum compatible with safety, which was far below the present values. Such thin walls could be applied only in corrugated sheathing.

The advantages of thin-walled aluminium sheathing seemed so great that even where the high conductivity of the aluminium sheathing was required as a neutral in power cables or as an induction screen in telephone cables, it might be more advantageous and less expensive to put a layer of aluminium or even tinned copper wire underneath the thin-walled, plastic-protected sheathing. By that means, the metal sheathing would furnish reliable protection to the core against moisture, leaving mechanical protection to the plastic coating.

Dr. G. L. D'Ombrain (Battersea Polytechnic) referred to a programme of research which was being conducted into the jointing of aluminium busbars under the auspices of the Electrical Research Association and confirmed figures given recently by Mr. J. C. Bailey. At about 1,400 lb/sq in a satisfactory joint could be made using Kynal as a jointing compound. In the absence of some such compound, about 1,700 lb/sq in was necessary. In all the surface treatments tried, Kynal was the best of the jointing compounds. The difference between silver and Kynal was too small to warrant the extra expense of the former. In heat-cycling tests with jointed bars, they found a small deterioration immediately or within the first two or three heat cycles of about 5 per cent in joint resistance, which then became more or less stabilised, but it was too early to draw any definite conclusions.

Mr. G. Wahlgren (Svenska Elfrabriks ab Selfa) said that for their switchgear his firm had changed experimentally from cast-iron to a light silicon-aluminium alloy without any copper. They were concerned not with the costs but only with the technical advantages. He had been surprised to learn how little switchgear apparatus was made in aluminium.

Transformer Performance

Mr. L. H. Fuller (South Eastern Electricity Board) said that for many years manufacturers had been putting in alternative tenders for transformers having various losses and should be able to say from their records which had been most successful. The use of aluminium should not be allowed to increase the iron loss of a transformer in any way. He hoped the manufacturers would not let cold-rolled steel inhibit them any more than it had with copper.

Mr. G. D. Castell (Hackbridge & Hewittic Electric Co.) said that the differences in design, performance and costs between copper and aluminium at present were marginal. Transformer manufacturers should gain all the experience they could by making aluminium windings before some factor made it essential to give the matter more serious consideration. It would be a great help if some users could accept aluminium transformers and provide operational experience. Two factors could lead to a changeover, price and availability. Regarding availability, it might be better to use what copper was available for the windings of oil-immersed transformers and to use aluminium for busbars, risers and switch connections.

Mr. C. R. Vassel (Ministry of Chemistry and Energy, Hungary) said that many problems in the making of aluminium sheaths by direct extrusion had not been solved anywhere in the world. One Hungarian works claimed to have devised a new press which would give continuity, but nothing could yet be said about the operation.

Mr. E. T. Norris (Ferranti) said that the French and German papers showed that aluminium had been used entirely for six or eight years over the whole mass of Western Europe. There must be an enormous amount of experience in the manufacture and the use of such transformers of which the papers said nothing. British and American manufacturers were exploring the possibilities of aluminium and different techniques and changes in construction, and it was sad that they did not have some means of drawing upon all that information.

Chemical Jointing Compound

Mr. H. B. Grainger (I.C.I.) said that the use of a chemical jointing compound for the preparation of low resistance joints in busbar systems could no longer be regarded as in the development stage. He gave details of the aluminium busbar system installed in February, 1954, to feed the furnaces of the first titanium melting plant commissioned in this country, in which Kynal jointing compound was used for the preparation of all joints. The installation had been operating satisfactorily for three years, and results presented for a 16-month period indicated that no deterioration in joint ratio had occurred.

Mr. W. R. Cox (General Electric Co.) said that aluminium had been used for 40 years, but had not developed more quickly for three main reasons: first, until recently there had been little differentiation in price; second, the control of manufacture had been very much improved in recent times, thus reducing corrosion and other troubles; third, engineers, both suppliers and users, preferred to deal with the devil they knew rather than the devil they did not know.

Mr. F. Hirschmann (Arc Manufacturing Co., Ltd.) said he had found it useful to introduce between the coils of transformers aluminium cooling plates, the cross-section depending on the heat flow through the sheet. The sheets were anodised and silicon varnished to give additional mechanical protection to the anodising layer. By this means the coils could be put immediately on top of each other, thus obviating the air gap which was otherwise necessary to get the same cooling surface. If aluminium strip with a cross-section of about $\frac{3}{8} \pm 0{\cdot}1$in and aluminium wire of 12 or 10 gauge, both anodised, were made available to the smaller manufacturers so as to avoid the need for them to order special batches of 5 tons minimum, that would do something for the introduction of aluminium for transformer windings.

Mr. Thomas (Monsanto) said the use of anodised strip for transformer windings, which might be immersed in fire-resistant coolants withstanding a temperature of 150 deg C without deterioration, would result in greater compactness and greater cooling efficiency, and the advantages of a liquid dielectric as compared with air; there would also be savings in cost. In aluminium oxide they had an insulation that was inorganic, insoluble and heat resistant, occupying the minimum of space to compensate for the extra bulk of aluminium windings. His firm had not been able to find in this country wire or strip having an anodised coating of sufficient strength or quality and were held up in their researches.

Mr. J. A. Prescott (English Electric Co.) said the reason why the consumption of aluminium in the electrical industry in Germany was 16 per cent and in this country only $7\frac{1}{2}$ per cent was partly because until the last couple of years there had been little co-operation between the aluminium industry and electrical manufacturers. The electrical industry had to do practically all its own investigations to discover how to use aluminium. Alloyed and pure aluminium looked very similar. A code of dots and dashes or colours might be employed so that users could

tell what they were using. In his concern only one grade was allowed in the factory at one time to obviate risk of a mix-up.

Mr. D. H. Smith (Brush Electrical Engineering Co.) said a radical change in the price differentials would be required before aluminium could be substituted for copper in distribution transformers. For generator transformers, where iron loss was not necessarily important, an economic design could well be produced at no great increase in cost. If authorities would order one or two using aluminium valuable data could be gained about operating experience and mechanical strength.

Inaugural Luncheon

The Council of the Aluminium Development Association entertained the authors of papers, the session chairmen and other special guests at a luncheon at the Savoy Hotel on 16th May. The guest of honour was Mr. Reginald Maudling, Paymaster General, and other notable guests included Mr. Aubrey Jones, the Minister of Supply, and Mr. Robert Carr, Parliamentary Secretary to the Ministry of Labour and National Service. Mr. E. Player, vice-president of the Association, presided in the absence of Dr. Maurice Cook, the president, who is overseas.

Referring to the advantages of aluminium from the electrical engineer's point of view, the chairman pointed out that it was far cheaper to-day than copper alloys on the basis of equal current-carrying capacity or of equal volumes of each metal. Substantial economies in dead weight and power costs could be made by the intelligent use of aluminium, and such economies could become apparent both in orthodox transport systems and in engineering erection schemes. Another advantage, continued Mr. Player, was that of availability. The known ore reserves of most base metals—copper, tin, lead, etc.—were comparatively limited. Aluminium ores by contrast were widely distributed over the earth and even known deposits were of enormous magnitude. It was particularly gratifying, he concluded, that so many leading members of the electrical industry were present, including a number of representatives from overseas, to contribute papers and join in the discussions. There were visitors from Canada, the United States, France, Switzerland, Germany, Italy, Hungary and the U.S.S.R.

Jugoslavia's Electrical Trade

ABOUT three years ago a law was passed in Jugoslavia regulating the representation of foreign firms by specialised import agencies. The basic principle of this is that only enterprises included in the "Foreign Trade Register" may engage in import trade. These organisations may act as intermediaries on behalf of foreign firms, with the right of conclusion of sales or service contracts; carry out the functions of commercial representatives together with servicing and the rendering of technical and other services; and sell goods from consignment stocks.

Under Jugoslavian regulations the local import agencies are permitted to transact business involved in the representation of foreign firms without a formally concluded and approved contract for account and on behalf of their foreign trade partners. Such negotiations should, however, be reported to the appropriate Jugoslavian authorities, in order to obtain a temporary permit, valid up to six months. The import organisations work on an exclusive agent commission basis, in most cases representing the complete manufacturing programme of the foreign producer for the whole territory of Jugoslavia. Exceptions are permitted only in cases of a variety of entirely different products made abroad in various factories of the same manufacturer.

Latest reports from the Federal Government's Foreign Trade Committee indicate that Jugoslavia's foreign trade is going to be increased by 23 per cent during this year. Increased imports of capital equipment should enable the country to achieve the planned 15 per cent increase in production and ensure greater stability.

Jugoslavia's electrical imports, after a decline during 1954, increased to some £8 million in 1955 (Table 1). In the first half of last year, her electrical imports stood at £3 million, or 3·27 per cent of her total imports. West Germany, as in former years, remained the principal supplier for the whole range of electrical machinery and apparatus. After a temporary setback in United Kingdom exports in 1955, last year's trade figures indicate a rise, particularly in industrial furnaces and switchgear. Jugoslavia's principal imports are shown in Table 2.

For the country's ambitious power plans, Jugoslavia will in future require substantial quantities of electrical goods, particularly power generation and distribution material, and she also will try to expand her local electrical industry, whose lines include rotating machinery, transformers, cables, telephone apparatus, meters and radio receivers. Her electrical exports, valued at less than £500,000, are mainly directed to Greece, Turkey and the Middle East, the principal products being installation and winding wire, rotating machinery, meters and batteries. (Exchange rate: £1 = dinar 840.)

The progress of power schemes in Jugoslavia included the completion of the Kakanj thermal power station, as well as the Jajce hydro station and the inauguration of the first three power units at Jablanica. The generating capacity was thus increased from 51 MW in 1945 to 263 MW in 1956, while the output rose from 62 million kWh to 800 million kWh. Plans for the second stage of the Kolubara thermal station envisage the installation of two additional boilers and another turbo set increasing the plant output from the present 64 MW to 130 MW.

TABLE 1.—ELECTRICAL IMPORTS 1953-1955 (000 dinar)

Country	1953	1954	1955
United Kingdom	553,214	891,112	561,256
Austria	973,044	592,001	632,006
Belgium	528,565	n.a.	n.a.
France	902,597	338,570	479,612
Italy	827,892	715,090	1,235,903
Switzerland	1,280,016	1,033,855	n.a.
West Germany	2,710,816	1,676,066	2,336,593
Total, including other countries	7,522,243	5,024,832	6,674,798

n.a.—not available.

TABLE 2.—PRINCIPAL ELECTRICAL IMPORTS (000 dinar)

Product	1954	1955	Jan.-June, 1956
Motors, generators and convertors	476,893	580,536	176,263
Starting equipment	98,837	184,157	160,329
Measuring instruments	131,162	221,934	113,830
Radio transmitters	98,837	184,157	160,329
Telegraph apparatus, other than radio	27,077	97,465	136,883
Electronic tubes and photo-electric cells	91,489	210,171	78,880
Accumulators	63,371	58,156	58,286
Power cables	483,733	597,094	202,810
Installation material	39,018	222,226	66,485

History of Electric Wiring

A Fundamental Section of the Industry

By FORBES JACKSON, M.I.E.E., M.I.Mech.E.

IN a useful, interesting, even fascinating book,* Mr. John Mellanby has set out the developments in electric wiring from 1870 to 1956 and in doing so has related them to the historical background of the electrical industry as a whole.

The author claims that the art of wiring is an essential link between the supply authority on the one hand and the consumer of electricity on the other. He does not accept the view that wiring is a barely "respectable" occupation for anyone with academic qualifications. It is a branch of the profession of electrical engineering and as his record shows many famous electrical engineers have contributed notably, not only to the elucidation of wiring principles, but to the detail design of accessories.

The broad history of the art is set out in six chapters, each dealing with a period. Each chapter is headed by a quotation from some contemporary document, the quotation having a bearing on the development of the period. Period 1900-1920 opens with an extract from the annual report of a supply company pointing out that the drop in receipts per consumer, because of the introduction of metal filament lamps, was only temporary and that the consequent cheapening of light was already bringing in more consumers. Period 1920-1939 is headed with a reference to the setting up of the Electrical Development Association "to teach the public the advantages of using electricity." For the period 1939-1956 the author quotes the recommendation of the No. 11 Study Committee for an all-purpose fused plug wired on a ring main.

Early "Electricians"

The author reminds us that in these early days the term "electrician" had a wider meaning than it has to-day. The I.E.E. was then known as the Society of Telegraph Engineers and Electricians and all the great men who began the electrical industry, Kelvin, Ferranti, Crompton, were so called. The practice still lingers in some quarters and I remember one of the famous architectural town planners, at the Bankside inquiry in 1946, referring to Sir John Hacking as the Central Electricity Board's "electrician."

From these chapters emerge the general pattern of development and also the general pattern of rules, codes and standards so familiar to us to-day. The I.E.E. Wiring Regulations, now universally accepted in the industry, were early in the field (1882), but for many years were overshadowed by the rules of the Phœnix Fire Office drawn up by that redoubtable figure Musgrave Heaphy. These rules were widely followed up to the first decade of the present century and, judging from a copy now in my possession, they were very good rules. There is much other interesting material in these chapters and those who, like myself, have often wondered why the Factory Regulations make no specific reference to no-volt release, will find the answer.

The Victorian and Edwardian electricians—using the term in its widest sense—were a vigorous and enthusiastic body of men and deserved success. One gets a mental picture of them striding through Victorian houses—and marble halls—complete with frock coat, followed by carpenters erecting capping and casing and fabricating wooden boxes for switches, fuses and fittings most of which had been designed and even made in the "electrician's" own workshops.

Domestic Electricity in the 'Nineties

Mr. Mellanby's book contains a drawing taken from a G.E.C. catalogue (1891) showing a typical wiring diagram of the ground floor of, presumably, a typical house. It has a drawing room, dining room, morning room, library, kitchen, scullery and two flights of stairs. At that time the cost of domestic installations was of the order of 35s a point, a formidable figure compared with the general price level of the period. The only lamps available were carbon lamps (four watts per candle) and they cost 3s 9d each. The price of electricity depended on where you lived, if indeed you could get it. For reasons of economy gas was often retained to light the servants' quarters.

The invention of the gas mantle in 1896, some 15 years before the development of the metal filament lamp, meant that for domestic purposes gas was cheaper and electric lighting was confined to the higher income groups. The metal filament lamp was produced about 1910 but it was not until after the first world war that small houses began to be wired in any quantity and even up to 1930 many local authority houses were built without electrical installations. After that electricity became a "must" even for the smallest houses. By this time there was a great variety of good fittings at reasonable prices. Moreover, since these houses were usually built in lots of several hundreds at a time, the electrical installation work as well as the building work could be economically planned in advance. It was the writer's experience that in the 'thirties it was possible to wire such houses in a thoroughly workmanlike manner for ten or twelve shillings a point. It has always surprised me that the larger electrical contractors tended to ignore this type of business for it was the kind of work where good organisation would earn a profit.

Contractors' Organisations

Mr. Mellanby has, I feel, made two omissions in his general history of developments. There appears to be no reference to the National Register of Electrical Installation Contractors and only a passing reference to the Electrical Contractors' Association. Both of these bodies have exercised a considerable influence in the development of electric wiring.

The chapter on Kelvin's work is full of interest. Kelvin was responsible for a number of the early electrical installations including that at Glasgow University and at Peterhouse, Cambridge, in 1883. The latter was a gift to his old college. These and a number of other early installations he designed personally, even to the details

* "The History of Electric Wiring." By John Mellanby, M.A. (Cantab.), A.M.I.E.E., M.Inst.F., M.I.H.V.E. Pp. 244; figs. MacDonald & Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 32s 6d.

of switches, and many of the components were made in the workshops of James White with whom Kelvin was subsequently associated as Kelvin & White.

There follow a number of chapters, each dealing with some particular accessory or material, cables, conduits, switches, lampholders, plugs, fuses, trunking, ducts and even prefabrication. These are well documented, copiously illustrated and form a valuable record.

Because of their earlier use in telegraphy, cables had many years of development before the demand came for electrical installations. The relative merits of rubber and gutta-percha had been more or less settled and manufacturing processes for applying the insulation and a lead sheathing had been solved. The early installations all made use of capping and casing and rubber-insulated cables so that no new problem had to be worked out. The greatest difficulty was standardisation of sizes and something like chaos seems to have reigned until the Cable Makers' Association (formed in 1900) took the matter in hand. There is much historical data in the chapter which leads up to the position to-day in which, for general work, there are two main systems—either conduit or t.r.s. (or its plastic equivalent).

On the question of plugs and sockets Mr. Mellanby shares the view that the Study Committee's recommendation of a fused plug and a ring main was a wise one, and expresses surprise that this conclusion was so tardily come to, i.e. in the Appendix. The fact is that there was strong user pressure on this committee from the start for this development but equally strong resistance from the manufacturing interests who maintained that a safe and satisfactory fused plug could not be made. It was at this juncture that Dorman & Smith, who had been invited by a member of the committee to attack the problem, produced a solution by putting the fuse in the live pin. This evidence that a fused plug was possible undoubtedly turned the scale and for once the users got what they wanted and not what the manufacturers wanted to sell them. After that it took two years of argument before a British Standard was produced. In a sense Mr. Mellanby is right when he refers to the Dorman & Smith " version " of the ring circuit system but it is more than that. It was the father and mother of all ring circuit plugs and for several years it was the only one available. Without it we should have had no ring circuit to-day.

This is a most interesting book which should be read by electrical engineers of all ages and particularly by those whose work is in the installation field. The older members will recall their own experiences in, and contribution to, a developing industry and see the answers which time gave to matters on which there was great argument. The younger ones will get a fascinating and intimate look into the past and may learn the lesson that no industry remains static, that they are still working in an age of development and must be ready to try new methods themselves.

CONTRACTORS AT LLANDUDNO

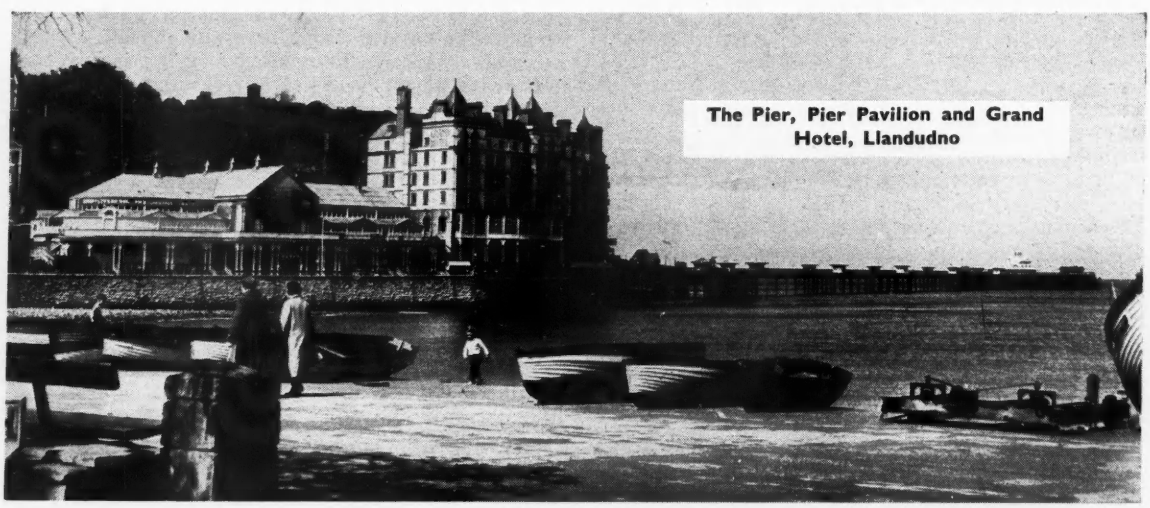
Arrangements for the Annual Conference of the E.C.A.

THIS year's conference of the Electrical Contractors' Association and its allied organisations, N.E.C.T.A., Ltd., and the National Federated Electrical Association, is being held at Llandudno. Delegates will register next Sunday and in the evening there will be a musical " get-together " at the Grand Hotel.

On Monday morning there will be the customary civic reception, at the Pier Pavilion, and the president (Mr. A. V. Milton, Associate I.E.E.) will deliver his address. A full morning will conclude with the presentation of a paper by Mr. V. J. Stock entitled " Electrical Contracting —Science or Guesswork ? " which will be discussed.

A garden party has been arranged for Monday afternoon and in the evening the president will hold a reception at the Winter Gardens Ballroom and there will be dancing.

The annual general meeting will be held at the Pier Pavilion on Tuesday morning and the afternoon will be devoted to an " Any Answers Please " session at which a representative panel will deal with questions put by members. This will be followed by the installation of the new president who will give a short address. The final item will be a reception by the chairman of the Llandudno U.D.C. at the Winter Gardens Ballroom.



The Pier, Pier Pavilion and Grand Hotel, Llandudno

VIEWS on the NEWS

By REFLECTOR

OLDHAM (Lancs) has abandoned its tramways but the poles for the overhead lines remain and are saving the town money. Street lighting is being changed over from filament to fluorescent lamps and recently the lighting superintendent told the Surveyor's and Building Committee that some of the tramway poles which were being used for the new lighting had been in service for fifty years. To replace them all would cost the Council £52,000. But whether the poles conform to æsthetic standards is probably disputable.

While on the subject of lamp standards, I may record that at Richmond (Surrey) where there have recently been protests against the use of concrete posts around the Green, the Highways Committee has decided to experiment with cast-iron lamp columns. These, it is hoped, will be more in harmony with the Georgian buildings there.

* * *

In its May issue *Electron* (the official organ of the Electrical Trades Union) returns to its attack on the Electricity Bill and is, as usual, very vituperative. Mainly on account of the Government's decision to drastically curtail the manufacturing powers of the proposed new Generating Board, *Electron* says:—

> "The electricity supply industry is to be sacrificed to the vested interests of monopoly capitalism which form the heart and core of the Tory party."

In my view the industry, far from being "sacrificed," will be able to get on with its job of generating and supplying electricity, leaving private enterprise (which can do it much better) to supply the necessary plant and equipment.

* * *

The latest fish story comes in a *Reuter* message from Bonn where, it is stated, goldfish are to act as a warning "device" for any gamma rays which may escape from the large cyclotron at the University.

> "The cyclotron, nearly 50 feet below ground, is surrounded on all sides by thick concrete walls. Above it, as an additional safeguard, there is a goldfish pond. If harmful rays should escape, the reactions of the goldfish would show immediately."

* * *

One of the delicacies sold in the markets of Baghdad is *kebabs*, also known as *shashliks*. A correspondent tells me that electricity is now being used in the preparation of this convenient food for the customer. There is no dish involved; each portion consists of a set of small pieces of meat, each suitable for a single mouthful, skewered on a piece of stiff wire or slender stick of bamboo. The wire is about nine inches long, and is rested on the edge of a metal tray about an inch deep, on the bottom of which a thin layer of charcoal is burning. Traditionally, a forced draught is provided by a lad who fans the dish of charcoal with a plaited palm-leaf fan while kebabs are being cooked and then allows the fire to smoulder very gently between orders. A few modern market stallholders, inspired by the possibilities of "electrification," use an electric fan with a tilting head standing at the end of the counter on which the cooking is done. While the fire is needed the fan is tilted downwards to give a steady draught and provide a bed of red-hot charcoal which grills the meat briskly. As soon as the portion is cooked, the fan can be tilted up, and then it serves to drive the flies from the meat and to keep the smell of food issuing from the stall in a steady stream to attract other customers.

* * *

I have just seen a *Daily Mirror* "Do-it-Yourself Week-end Special" in which suggestions are made for the lighting of a sitting room. As advice on adequacy and proper placing of lighting arrangements the article is admirable; it seems to have been based on a scheme devised by one of the leading electric lamp makers. But although the reader is warned against too much trailing flex, frayed flex and the overloading of outlets, the risk remains that he will attempt to carry out the wiring himself; indeed it would seem to be the object of the article to encourage this. Therefore, I doubt the efficacy of a panel reading:—

> "Unless you're an expert, the *Daily Mirror* strongly advises you to call in a qualified electrician for any new wiring or alterations you may wish to make in your home."

* * *

An interesting example of farm electrification sixty years ago was recorded in the *Electrical Review* of 21st May, 1897:—

> "In a recent United States Consular Report, an extremely interesting electrical installation which exists on a farm at Mecklenburg in Germany, is described, and which actually is stated to be worked at a profit. The power is originally obtained from a small brook, the water of which drives a turbine at about 16 horse-power, connected to a continuous current dynamo. Of course, there is a storage battery, by means of which the energy of the brook is stored up during the time when the farm machinery is not in operation. Conductors lead to all parts of the farm, driving motors for threshing, sawing logs, straw cutting, pumping and small machine tools, the farthest motor being 1,800 feet from the dynamo. The plant is run at about 140 volts. This installation during the year furnished 34,000 horse-power hours of energy, including 120,000 lamp hours of lighting. The cost of the plant was $12,376, of which the electrical part figured at $7,140. The working expenses, including interest and depreciation, amounted last year to $1,428. The former working expenses were $1,713.60. This shows a difference of $285.60 in favour of electricity. But in addition to this there is gained the advantage that four horses can be dispensed with, whilst the remaining horses are always ready for use."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Power has appointed **Mr. H. Milton Morgan,** of Broughton Hackett, Crowle, nr. Worcester, as a part-time member of the Midlands Electricity Board.

Sir George H. Nelson, Bt., chairman of the English Electric Co., Ltd., received the honorary degree of Doctor of Laws from the University of Manchester on 13th May.

The South of Scotland Electricity Board announces that **Mr. Andrew A. Wallace,** F.A.C.C.A., has been appointed secretary of the Board in succession to **Mr. J. Meek,** solicitor, who retires on 30th June. Mr. Wallace has had forty years' experience of the electricity supply industry. Before nationalisation he was chief accountant of Glasgow Corporation Electricity Department. Subsequently he held the office of chief accountant of the South West Scotland Electricity Board and on the reorganisation of the industry in Scotland, following upon the passing of the Electricity Reorganisation (Scotland) Act, 1954, he became deputy chief financial officer of the present Board.

Mr. A. A. Wallace

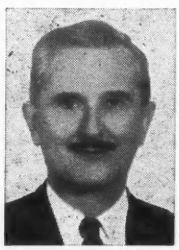
At the meeting of the Council of the Public Transport Association held on 9th May, **Mr. J. M. Birch** retired from the chair of the Association which he has occupied since May, 1955. The new officers of the Association are **Mr. T. R. Williams,** who was elected chairman, and **Mr. A. F. R. Carling** and **Mr. R. E. Chisnell,** who were elected the vice-chairmen for the ensuing year.

Mr. Williams is chairman or director of the Aldershot & District Traction Co., Ltd., and a number of other transport companies.

The annual dinner of the Association will be held at the Connaught Rooms, London, on Thursday, 14th November next.

The Northern Aluminium Co., Ltd., announces that **Mr. J. H. Mayes,** formerly assistant general sales manager, is now general sales manager in succession to **Mr. S. E. Clotworthy** who has become managing director following the appointment of **Mr. F. W. Bruce** as president of the Aluminum Company of Canada.

Mr. J. Appleby, A.M.I.E.E., M.I.Mech.E., M.Am.I.E.E., chief engineer of the Compania Anonima Luz Electrica de Venezuela, Caracas, informs us that he is leaving Caracas at the end of this month for Mexico City to take part in an engineering conference. His company is affiliated to American & Foreign Power Inc., New York, which is arranging the conference for its many companies in the Latin Americas. After this Mr. Appleby will come to England, arriving here on 17th June, and apart from occasional visits to engineering works on the Continent expects to stay in London until the end of July. During this time his address will be c/o the Canning Club, 1, Hamilton Place, London, W.1.



Mr. J. Appleby

Mr. J. H. Bowen informs us that he has ceased to be connected with John Bowen Fittings, Ltd., and Payne & Penny, Ltd., but retains his directorship in "J.H.B." Properties, Ltd.

Mr. J. B. Woodeson, O.B.E., has been appointed chairman of the Water-Tube Boilermakers' Association in succession to **Mr. R. B. Potter,** whose three years' term of office was completed on 25th April, and **Mr. W. Messer** has been appointed vice-chairman. Mr. Woodeson is chairman of Clarke, Chapman & Co., Ltd., and Mr. Messer is a director of International Combustion, Ltd., and associated companies. **Mr. G. J. Stanner** has been appointed secretary of the Association and **Mr. G. S. Horne** has been appointed assistant technical officer.

Mr. J. B. Woodeson

Mr. W. Messer

Mr. G. J. Stanner

Mr. G. S. Horne

Mr. W. J. A. Gemmell, B.Sc., A.M.I.E.E., manager for Scotland for the Lancashire Dynamo group of companies, has been presented with an inscribed gold watch to mark his twenty-five years' service with the company. The presentation was made in London on 14th May by Mr. S. F. Steward, chairman of Lancashire Dynamo Holdings, Ltd.

Mr. F. L. Levy, joint managing director of George Cohen Sons & Co., Ltd., has been elected president of the National Federation of Scrap Iron, Steel and Metal Merchants.

Mr. R. R. Coventry, who has joined Ascot Lamps & Lighting, Ltd., as assistant sales manager, has spent many years in the lighting business. He was for twelve years assistant to the sales director of Thorn Electrical Industries, Ltd., and for three years was sales manager of Stella Lamps, Ltd. **Mr. A. A. Tucker,** for twenty-two years chief purchasing officer and transport manager, Ismay Lamps, Ltd., has also joined Ascot Lamps & Lighting, as purchasing officer and office manager.

Mr. R. R. Coventry

Mr. A. A. Tucker

At the annual general meeting of the British Seamless Rubber and Plastics Manufacturers' Association, held on 16th May, **Mr. S. D. Sutton** (Veedip, Ltd.) was elected chairman for 1957 and **Mr. A. R. Reid** (London Rubber Co.) vice-chairman.

The **Television Society** has awarded the following premiums for outstanding papers read before the London meetings in 1955-56:—*Electronic Engineering* Premium: Mr. D. C. Birkinshaw (B.B.C. Television) for his paper on "Progress in American Colour Television." Pye Premium: Mr. R. A. Dilworth (Post Office Engineering Department, Radio Branch) for his paper on "Interference with Television Reception: Its Causes and

Cures." E.M.I. Premium: Mr. A. H. Atherton (E.M.I. Research Department) for his paper on "The Secondary Emission Valve and its Applications." Mullard Premium: Dr. R. L. Smith-Rose (D.S.I.R. Radio Branch) for his paper on "Properties and Problems of Bands IV and V." Mervyn Premium: Mr. H. A. Fairhurst (Murphy Radio, Ltd.) for his paper on "The Development of a 21in Colour Television Receiver." *Wireless World* Premium: Mr. A. V. Lord (B.B.C. Research Department) for his paper on "Some Problems in a Band-Sharing Colour Television System."

Mr. Brian Bromwich has been appointed chief press officer of the General Electric Co., Ltd., in succession to Mr. **D. C. Rogerson**, whose appointment as deputy publicity manager (engineering) we reported in our last issue. Mr. Bromwich joined the G.E.C. about a year ago as assistant press officer. Before that he was for two years public relations officer to Vickers-Armstrongs (Aircraft), Ltd., and was previously on the editorial staff of the *Financial Times* for six years, being appointed air correspondent in 1949 and industrial correspondent in 1952.

Mr. B. Bromwich

The golf competitions in aid of the Electrical Industries Benevolent Association at the **British Electrical Power Convention** at Eastbourne this year will be held at the Royal Eastbourne Golf Club. The ladies' competition for the Lady Citrine Rose Bowl will be played in the morning and afternoon of Wednesday, 19th June. The men's competition for the G. P. Dennis Trophy will be played in the morning and afternoon of Monday, 17th June. These competitions are not confined to delegates, and any *bona fide* members of the electrical industry may enter. Non-delegates wishing to enter should get in touch with Mr. C. F. Boyes, General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, and after Friday, 14th June, at the Queens Hotel, Eastbourne (telephone: Eastbourne 2800).

The "Atlas" Lighting Division of Thorn Electrical Industries, Ltd., announces the appointment of **Mr. H. Foster** as area sales supervisor, South Western Area. Mr. Foster, who was formerly with the A.E.I. Lamp & Lighting Co., Ltd., joined the B.T.H. Co. in 1935 to represent it in Birmingham and Leicester. In 1936 he was appointed manager, lamp and lighting sales, Sheffield office, and in 1940 was transferred in a similar capacity to Bristol and the south west. He was chairman of the Bristol Electric Club in 1952 and is still on the committee. He is also a member of the committee of the Bristol, Bath and North Somerset Branch of the E.I.B.A.

Mr. H. Foster

Dr. F. A. Tatford, chief purchasing officer of the United Kingdom Atomic Energy Authority, is being appointed director of contracts in succession to **Mr. R. A. Browning,** O.B.E., who is retiring in the near future. Dr. Tatford's office will be at 1, Richmond Terrace, Whitehall, London, S.W.1.

Mr. J. R. V. Dolphin, who has been chief engineer to the weapons group of the United Kingdom Atomic Energy Authority since 1951, has been appointed chief engineer to the Authority's research group. He will take up his new duties at Harwell on 1st August.

Mr. G. E. Clifford, B.Sc., Ch.E., A.I.Ch.E., has been appointed technical director of Air Control Installations, Ltd. Mr. Clifford has been chief engineer of the company since 1936 and joined the board as alternate director in October, 1955. **Mr. H. C. S. Brand,** M.A., A.I.I.A., has been appointed works director. For the past six years he has been works director at Addis, Ltd.

Mr. John Brown, M.A.(Edin.), Ph.D., lecturer at University College, London, has been appointed to the University Readership in Electrical Engineering, tenable at University College.

The silver jubilee celebration luncheon of the Harrogate and District Branch of the **Electrical Association for Women** was attended by 150 members and guests on 29th April at the Cairn Hydro Hotel, Harrogate. Nine visiting branches of the north eastern area were represented. Mr. W. K. Fleming (manager of the North Eastern Electricity Board's Harrogate Sub-Area), Mrs. Fleming (vice-president) and Mr. C. R. Taylor (commercial officer, Harrogate Sub-Area) were present. The president, Mrs. F. H. Topham, was in the chair. The toast "The Electrical Association for Women" was proposed by Mr. N. F. Marsh (deputy chairman, North Eastern Electricity Board), and Miss Mary George (director, E.A.W.) responded.

Mr. L. T. Giles, Associate I.E.E., M.Inst.F., hitherto station superintendent, Ferrybridge "A" power station, has been appointed superintendent of the Ferrybridge "A" and "B" stations. Mr. Giles entered the electricity supply industry in 1927, serving an apprenticeship with the Guildford Corporation Electricity Department. From 1932 to 1950 he held various positions at Guildford, Letchworth, Slough Trading Estates, Ltd., and Portishead power station, Bristol. In 1950 he became superintendent of the Barugh, Barnsley, and Wakefield power stations and was appointed station superintendent, Mexborough, in 1951, a position which he held until 1956 when he went to Ferrybridge.

Mr. L. T. Giles

Members of the South Wales Branch of the Association of Mining Electrical and Mechanical Engineers who recently visited the Fraser & Chalmers Engineering Works, Erith, of the G.E.C. Mr. A. B. Price (sales manager, Fraser & Chalmers) is seated in the centre. On his left is Mr. R. D. Williams (secretary of the Branch,) and on his right Mr. R. Hamilton (chairman)

Princess Margaret with Mr. A. G. Clark (chairman and managing director of the Plessey Co., Ltd.) during her visit to the company's Swindon Works

Princess Margaret visited the industrial hydraulics factory of the **Plessey Co., Ltd.,** at Cheney Manor Trading Estate, Swindon, on 16th May.

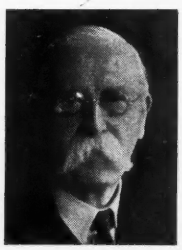
The Princess was welcomed by Mr. A. G. Clark, chairman and managing director of the company, Mr. R. Keir Watson, executive director of the company at Swindon, and Mr. D. G. Booth, divisional manager of the industrial hydraulics division. After signing the visitors' book, the Royal visitor toured the factory.

Before leaving, Mr. A. G. Clark presented the Princess with a midget transistorised radio set, as a personal memento of her visit.

Mr. E. Forth, B.Sc. (Elec.), M.I.Mech.E., generation engineer (operation), North Eastern Division of the Central Electricity Authority, has been appointed generation operation engineer, headquarters. Educated at the Grammar School, Wolsingham, and King's College, University of Durham, and apprenticed with C. A. Parsons & Co., Ltd., Mr. Forth joined the North Eastern Electricity Supply Co. as a student engineer in 1934 and was in the service of that company until the reorganisation of the electricity supply industry in 1948. From 1940 he held successive appointments in the North Tees power station of which he was latterly power station superintendent. He relinquished this post at vesting day to become generation engineer (operation) for the Southern Group and subsequently for the Northern Group of the Central Electricity Authority's North Eastern Generation Division.

Sir Wavell Wakefield, M.P., was elected president of the Electrical Vehicle Association for the fourth year in succession at the annual general meeting held in London on 15th May. The new chairman is Mr. J. A. Lowe (Westinghouse Brake & Signal Co., Ltd.), the vice-chairman is Mr. J. H. Cansdale (British Thomson-Houston Co., Ltd.) and the hon. treasurer Mr. H. E. M. Bull (S.E.V. (Sales & Services), Ltd.).

Mr. Philip R. Coursey, B.Sc.(Eng.), M.I.E.E., F.Inst.P., has retired from the position of technical director of the Dubilier Condenser Co. (1925), Ltd., but is remaining on the board of the company and is to act as technical consultant. Mr. Coursey was formerly chief engineer of the company and was appointed technical director in 1931. His activities connected with the electrical industry have been extensive. He is a member of various professional and technical institutions in this country, the United States and France. He is chairman of the B.E.A.M.A. Power Capacitor Technical Committee and a member of various committees of the E.R.A. all of which he is hoping to continue. He has published many technical papers to institutions and societies and is the author of several books concerning capacitors.



Mr. P. R. Coursey

Mr. R. S. Ewing has been appointed to the board of C.A.V., Ltd., as director in charge of production. He became general factory manager of the C.A.V. factories at Acton, Rochester and Sudbury (Suffolk) in 1955 and was previously production manager and later works manager of the Acton and Sudbury factories, having joined the company in 1935.

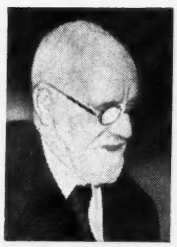
Mr. Ralph J. Cordiner, president of the General Electric Co., U.S.A., is visiting this country and on Monday next he will be entertained at a cocktail party at Claridges Hotel, London, given in his honour by the London directors of the International General Electric Co., of New York. Many distinguished men of all branches of the electrical industry will attend the party. Mr. Cordiner is a member of the Committee for Economic Development (U.S.A.), the Business Advisory Council of the Department of Commerce (U.S.A.), the National Electrical Manufacturers' Association (U.S.A.) and the American Management Association.

Mr. R. J. Cordiner

During his stay in this country Mr. Cordiner will visit some of the major industrial undertakings.

OBITUARY

Mr. Frank Christy, M.I.E.E., founder of Christy Bros., Ltd., chairman of the company up to 1954, and a director at the time of his death, died on 13th May in his ninety - second year. Mr. Christy, who received his training with Crompton & Co., began in business as an electrical contractor in 1883, his first contract being a 200-light installation in a Waterford factory. In 1900 he turned his attention to the development of electricity supply undertakings in small towns and rural districts and carried out a number of water power schemes, the largest being that on the River Tavy—about 4,000 kW. Before nationalisation he was chairman of the West Devon, Bude, North Somerset, Burnham-on-Sea and Aldeburgh companies. He relinquished the chairmanship of the Christy Bros., Ltd., group of companies in 1954, but retained his directorships. In December, 1955, his ninetieth year was celebrated with a party at Chelmsford, attended by directors and employees, when an illuminated address in album form, autographed by all employees of Christy Bros. and associated companies, was presented to him.



The late Mr. Frank Christy

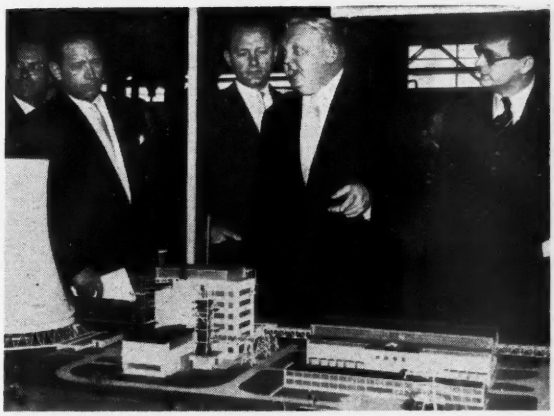
At the dinner-dance of Switchgear & Equipment, Ltd., Banbury (reported in our last issue). Left to right: Mrs. Oxley, Mr. A. G. H. Oxley (managing director), Mrs. Wilson and Mr. P. M. Wilson (chief engineer, South Western Electricity Board)

HANOVER FAIR

FROM A CORRESPONDENT

SINCE the opening of the first Hanover "export" fair in 1947, this town truly has become a major centre between East and West. The fairground, covering 690,000 sq metres, is situated about four miles outside the town centre and consists of 240,000 sq metres of exhibition halls, an additional area of 140,000 sq metres in the open and parking facilities for 40,000 cars. The number of exhibitors in 1947 was 1,300; this year there were over 4,000, including 480 foreign firms—51 from the United Kingdom. Well over 1,800,000 visitors attended this year's fair from 89 European and overseas countries.

The importance of the West German electrical industry within the country's economy was perhaps best reflected by its strong representation with 1,000 stands occupying about 74,000 sq metres partly in five of the 18 halls and partly in the open. Foreign participation as regards both visitors and exhibitors increased considerably over last year's. Among these, in order of their number, were Austria, France, Holland, Switzerland, the United Kingdom, the United States and Belgium. Official trade delegations included representatives from many parts of the world including China, Russia and the Eastern Bloc countries.



The German Federal Minister of Economics, Professor Erhard (with cigar), examining the model of Calder Hall at the British atomic energy display

The main attractions at this year's fair no doubt were the comprehensive displays by the United Kingdom

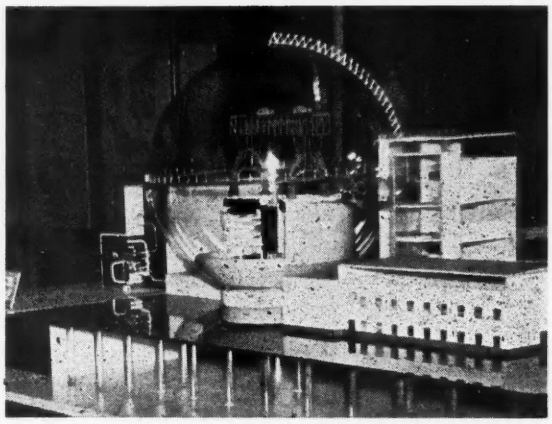
General view showing the main Fair area and the various specialised buildings

Atomic Energy Authority, showing nuclear power developments, and the stand of the Isotope Division of Harwell. The very nature of the nuclear exhibit, together with the looming danger of power shortage in Western Germany in the near future, not only attracted large crowds, but it also secured prominence in the Press, radio and cinema newsreels.

The nuclear power exhibit of the U.K.A.E.A., in collaboration with the Board of Trade and the Nuclear Energy Trade Associations' Conference, covering an area of 250 sq metres, included models of Calder Hall and Dounreay, artists' impressions of future power stations, charts and blueprints of nuclear components, supported by a film showing the basic principles of nuclear power generation. This extremely impressive exhibit showed the world that United Kingdom manufacturers are not only prepared to book orders for complete nuclear power stations, but also willing to enter into "know-how" agreements with overseas organisations. The Atomic Energy Research Establishment arranged an exhibit dealing with the industrial purposes of radioactive isotopes manufactured at Harwell and Amersham.

Among United Kingdom electrical manufacturers exhibiting at Hanover were Birlec, Ltd., Hoover, Ltd., Isotope Development, Ltd., Kenwood, Micalex, Solartron, and Sunvic.

Most of the displays of the leading German manufacturers were basically the same as last year, though the contents had been changed with not so much accent on heavy gear but on automation and other forms of electronic control.



Model of a Dounreay reactor shown in the atomic energy display

Conclusively, it can be said that the fair was a striking success and has gained in importance as one of the most widely attended exhibitions in Europe.

NEW L.D.C. BUILDING

INAUGURATION BY LORD MILLS

TO replace premises destroyed by fire in 1954 Lancashire Dynamo & Crypto, Ltd., have built a new block at their Trafford Park, Manchester, works at a cost of about £80,000 and this was inaugurated by Lord Mills, Minister of Power, on Thursday last week.

The company present at the ceremony included a number of directors and representatives of the civic, educational and industrial spheres of local activity. After a tour of the works the company assembled in the new building and Lord Mills was introduced by Mr. Stanley F. Steward, chairman and managing director of Lancashire Dynamo Holdings, Ltd., the parent company. He welcomed the appointment of Lord Mills as Minister of Power and referred appreciatively to his previous connection with the company.

Lord Mills, Minister of Power, and Mr. S. F. Steward, chairman of the Lancashire Dynamo Group, speaking to Mrs. A. P. Wood, widow of the founder of Lancashire Dynamo & Crypto, Ltd., whose portrait she has just unveiled

In responding, Lord Mills congratulated the company upon its achievements during the past sixty years and said that it was playing its part in the new industrial revolution which was being brought about by the development of nuclear power. Limitless possibilities were being opened up for the electrical industry. He then declared the new building open and unveiled a plaque recording the event.

After thanking Lord Mills for sparing the time to attend, Mr. A. W. A. Dick-Cleland, joint managing director of Lancashire Dynamo & Crypto, made presentations to those concerned with the actual building work and he then asked Mrs. A. P. Wood, widow of the founder and first managing director of the company, to unveil a portrait of her late husband. This she did in a graceful speech; the portrait is to hang in the new conference room.

Mr. H. W. Bosworth, formerly chairman of L.D.C. and a director of Lancashire Dynamo Holdings, concluded the proceedings with some recollections of Mr. Wood and the early days of the company with which he (Mr. Bosworth) has been connected for fifty years.

The new building, which fronts a main road, consists largely of offices but it also houses a modern research laboratory and an apprentice training school. By providing accommodation for the office staff, the new building will enable the company to give badly-needed extra space to production.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication.

Responsibility cannot be accepted for the opinions expressed by correspondents.

Engineering Status

MANY will sympathise with the views expressed recently by a correspondent in the *Electrical Review* concerning the lack of status enjoyed by the engineer compared with his colleagues in other professions. Nor is there much doubt that this lack of status has an adverse effect on recruitment to the engineering profession, a disability that Great Britain can now ill afford. However, your correspondent's suggestion that legislation should be promoted " . . . to restrict the title of engineer to those professional men who are, by training and examination, qualified to use it," is doomed in advance to failure.

The term " engineer " now covers a relatively small number of persons who are qualified in the sense that a barrister, solicitor, physician or architect is qualified, and tens of thousands of persons who are not, and who never will be, so qualified. The general public and the Press, are used to, and accept, this situation. It is very doubtful whether any Parliament could now be persuaded to pass legislation restricting the use of the simple term " engineer " to the select few; and even more doubtful whether such legislation, if passed, could be effectively enforced. Further, can Great Britain afford at the present time the controversy and upheaval that would be caused by any serious attempt to promote and enforce such legislation ?

But the situation does cry out for remedy, and I suggest that the need is to find an entirely new term to describe the qualified professional engineer. Such a term might or might not incorporate the word " engineer " (preferably not), but the term would require to be defined in law and its use by individuals be restricted by law. There would also require to be some form of standing committee, as broadly based as possible but appointed by, or recognised by, the Government, that would decide from time to time the qualifications required for any individual to be permitted to describe himself by the term agreed upon.

A scheme of this sort would seem to stand some chance of success. It would not conflict with established custom, nor would it deprive any individuals of any rights that they already possess. Perhaps some of your readers can suggest a suitable term.

Kirkuk, Iraq. H. W. S. MARSHALL, A.M.I.E.E.

Coal Dust Precipitators

IN the article under this heading on page 827 of your issue of the 3rd May you referred to the coal dust precipitators at Aberaman as being the first of their type and having achieved what is believed the highest efficiency recorded on a dry type precipitator in this country.

It will probably interest your readers to know that vertical flow precipitators for the same duty were installed by Lodge-Cottrell at Princes power station, Nechells, Birmingham, in 1928. They are still operating at high efficiency.

Further, it is doubtful whether the efficiency of the Aberaman precipitator is a record. A higher efficiency, only marginally below 100 per cent, is achieved by the dry type Lodge-Cottrell precipitators at N. M. Rothschild & Sons, Royal Mint Refinery, the first unit of which was installed in 1932.

Birmingham. E. R. WATKINS.

Scientific Education

THE Executive Committee of the Industrial Fund for the Advancement of Scientific Education in Schools has issued a report stating that an increase of 50 per cent in science laboratories of nearly 200 independent and direct grant schools which already have a sound scientific foundation on which to build will be realised in the next two years, as a result of grants made by the Fund. Over £3,000,000, subscribed by 141 industrial companies, has now been committed. Building grants to 187 boys' and girls' schools have been undertaken and 92 buildings should be completed this year. A total of 328 schools have been offered grants for scientific apparatus. The establishment of the Fund in 1955 was an industrial measure to help to increase the number of scientists and technologists in industry and the country, by giving assistance for building, expanding, modernising and equipping science buildings of independent and direct grant boys' and girls' schools, taking into account the volume and quality of existing science teaching.

It is stated that the opportunity for women scientists in industry is not yet as clear as it ought to be. The Committee feels that industry as a whole must give this more and urgent attention, but points out that actually more vacancies already exist than can be taken up.

The Committee reports that the Fund's action has already produced a further stimulus to the strong interest in science in the schools and notes that all boys in nearly all the independent and direct grant schools are to-day introduced to science at some stage in their education. The report concludes by stating that the Committee estimates that an increase of one-third of all boys and girls studying mathematics and science to advanced level in the independent and direct grant schools may well be achieved in the next few years. A list of subscribers, which includes a number of electrical companies, and the names of the schools benefiting under the scheme are given in the report.

Science Museum Power Gallery

A new electric power gallery at the Science Museum, South Kensington, was officially opened on Monday by the Minister of Education, Lord Hailsham. The gallery, which is at the end of the large hall near the main entrance, has been adapted to its present purpose at a cost of some £75,000, met partly by the Government and partly by the electrical industry. An early historical section includes a reproduction of Faraday's experiment in 1831 demonstrating the continuous generation of electricity and a photograph of his laboratory. Modern exhibits show the development of atomic power and there is a working model of a million volt impulse generator.

INDUSTRIAL NEWS

Engineering Wages Decision

At a conference of the 40 unions affiliated to the Confederation of Shipbuilding and Engineering Unions in London on Monday it was decided to accept the engineering employers' offer of a wage increase of 11s a week for skilled men, 10s for intermediate grades and 9s for unskilled workers. Acceptance is subject to any improvements which can be obtained in the conditions attached to the offer, which include a year's stabilisation and the reduction of restrictive practices. The negotiations with the employers were to be resumed yesterday (Thursday). At the conference on Monday a resolution moved by Mr. F. Foulkes (E.T.U.) that the alternative offer without conditions should be accepted was defeated by 641,000 votes to 518,339.

Cables for Atomic Power Station

W. T. Henley's Telegraph Works Co., Ltd., has been awarded the contract for the main power, auxiliary and control cabling for the new atomic power station being erected at Chapelcross Works, near Annan, Dumfriesshire, for the United Kingdom Atomic Energy Authority. Valued at approximately £500,000, the contract covers the supply and installation of some 65,000 yd of h.v. and l.v. paper insulated f.i.n.d. type cables, 131,500 yd of v.r. cables and 27,000 yd of mineral insulated cables. The contract is scheduled for completion by September, 1959.

Export Incentives

The formation of a National Roll of Exporters, similar to the King's Roll of Manufacturers established at the end of the 1914-18 war, was urged by Mr. T. Boyd Boyd, chairman of the Institute of Export, in his report to the annual meeting of the Institute on 15th May. He said that it was to improving the export performance of individual firms that future Government effort should be directed. Admission to a National Export Roll would be available only to firms who sold a high percentage of their production abroad, and Government contracts and orders on behalf of the nationalised industries would be given only to members on the Roll. Such action might induce in the directorates and managements of companies which had consistently refused to pull their weight in the export field, the fear that their competitors in the home market might benefit at their expense. Mr. Boyd Boyd reviewed the activities of the Institute and referred to its 21st anniversary which was celebrated by a series of functions in London and the provinces in November and December last. He concluded by saying that exporting was a task for experts, and these would be produced only through education and informed example. The Institute was founded, and existed, to provide both.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £234 10s 0d
Fire Refined 99·70%	ton £233 0s 0d
Fire Refined 99·50%	ton £232 0s 0d
COPPER Tubes ..	lb 2s 3½d
Sheet	ton —
H.C. wire and strip ..	ton £285 5s 0d
LEAD, English ..	ton £96 10s 0d
Foreign	ton £95 0s 0d
MERCURY	flask £88 0s 0d
TIN, block (English) ..	ton £763 10s 0d
ZINC, G.O.B. Foreign	ton £83 15s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 10⅝d
Sheet	ton —
Wire	lb 2s 7½d
PHOSPHOR BRONZE Wire	lb 3s 11⅛d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 26¾d—26⅞d

Overseas Electrical Trade

The value of exports of British electrical machinery and apparatus in April totalled £17,490,783. This was nearly £3 million less than for the preceding month and over £600,000 less than for the corresponding month of 1956. Practically all classes of electrical goods showed decreases. The total for the first four months of this year of £74 million is still £3 million higher than for the similar period of 1956. Details of electrical exports for last month will appear in our next issue.

Scottish Radio and TV Show

The Radio and Television Exhibition now in progress at Kelvin Hall, Glasgow, is the first Scottish one to be organised by the industry since the war and is the biggest radio and television show yet held outside London. All the leading manufacturers of receivers and aerials are exhibiting and almost all of them are showing new models not previously seen at the National Radio Show at Earls Court, London. The B.B.C. is transmitting sound and television shows from the Exhibition, and the Scottish commercial television company, which goes on the air on 31st August, is providing film and live programmes for the closed circuit within the Exhibition. The Radio Industry Council is again demonstrating the control of two television programmes simultaneously, one on Band I (B.B.C.) and the other (Commercial TV) on Band III. Trains equipped with television studios in the guards' vans and receivers in every coach are being run to Glasgow from various centres to take visitors to the exhibition which closes on 1st June.

Road Haulage Rates

The National Rates Committee of the Road Haulage Association has decided that, as from 20th May, road haulage rates applying on 1st December last will be increased by 6 per cent. At the same time the Committee recommends hauliers to remove the balance of the surcharge imposed during the Suez crisis.

Electric Vehicle Report

The annual report of the Electric Vehicle Association of Great Britain, Ltd., for 1956 shows that the total membership at the end of the year was thirty-eight, of which twenty-six were full members and twelve associate members (including B.E.A.M.A.). The approximate number of vehicles in use in Great Britain and Northern Ireland was 33,267, as compared with 32,161 in 1955, of which 22,467 were driver-seated vehicles and 10,800 pedestrian controlled vehicles. New registrations totalled 2,738. Of the 1,605 driver-seated vehicles included in this total, the greatest number (484) was in the 1-1½ tons class; next in order was the 12-16 cwt group (471) and the 16 cwt to 1 ton group (350). The number in the class not exceeding 12 cwt was 263.

The report records the activities of the Association at exhibitions and conferences, and its negotiations conducted with Government Departments and associations.

Sales Managers' Conference

The annual conference of the Incorporated Sales Managers' Association is being held this week-end at the Grand Hotel, Eastbourne. Lord Woolton will open the conference this evening (Friday) and among the papers to be read during the conference is one by Mr. D. T. L. Rettie, marketing director, Hotpoint Electric Appliance Co., Ltd., on "Balancing Productive Capacity with Sales Power."

Plant for Venezuela

An order has been received by the Metropolitan-Vickers Electrical Export Co., Ltd., for two main turbo-generator sets, each rated at 66 MW, for installation in Arriaga No. 2 power station at Maracaibo, Venezuela. They will be supplied complete with

all condensing, feed water heating, de-aerating and evaporating plant. The contract, the value of which approaches $3 million, was placed by the Montreal Engineering Co., Ltd., on behalf of its associates, the International Power Co., Ltd., of which C.A. Energia Electrica de Venezuela is a subsidiary. The whole of the plant will be manufactured at the Metropolitan-Vickers factories at Trafford Park and Germiston (Glasgow). The turbo-generator sets, which will run at 3,600 r.p.m., will have two-cylinder close-coupled turbines taking steam at 850 p.s.i.g. 900 deg F at the stop valve. There will be five stages of feed water heating including the de-aerator, with a final temperature of 390 deg F at the economical continuous rating. Twin-shell Metropolitan-Vickers condensers will maintain a vacuum of 27·38in Hg when supplied with cooling water at a temperature of 90 deg F. The generators, each having a maximum continuous rating of 82·5 MVA at 0·8 power factor and a short circuit ratio of 0·55, will supply 60 c/s a.c. at 13·8 kV. They will be hydrogen cooled. The first of the new sets is due to be commissioned in 1960.

Lister-Blackstone Anniversary Celebrations

Employees of the Lister-Blackstone group are to be the guests of the directors at the Bath and West Agricultural Show at Swindon on 1st June to celebrate the 90th anniversary of R. A. Lister & Co., Ltd., and the 120th anniversary of Blackstone & Co., Ltd. This year also marks the coming-of-age of the association of these two companies. Special trains will take the Stamford party, and a fleet of motor coaches will run in convoys from Dursley to Swindon.

Motors for America

A further large shipment of electric motors left the Huddersfield factory of Brook Motors, Ltd., for the Southern States of America recently. The consignment, packed in 400 cases, weighed about 45 tons and needed three large lorries, two of them with additional trailers, to transport it to the docks. This is a result of the activities of the Brook American subsidiary, Brook Motor Corporation of Chicago, whose business is now totalling one million dollars a year.

Crown Agents' Conditions of Contract

Revised Conditions of Contract which apply to orders placed by the Crown Agents on behalf of their overseas principals come into effect on 1st June. Copies can be obtained from the Crown Agents for Overseas Governments and Administrations, 4, Millbank, London, S.W.1. Reference O/Sec. 245 should be quoted.

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ.

In each case the rate of pay for adult male labour at 17th May is deemed to be 175s.

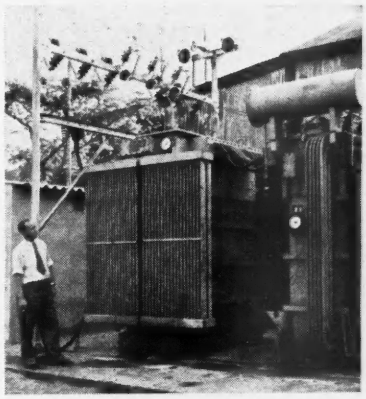
The "costs of materials" figures are: For electrical machinery and equipment the Board of Trade index figure published on 17th May is 182·7. For turbo-generating and allied plant: Materials used in mechanical engineering industries 181·1, blast furnaces and iron and steel melting and rolling (40 and 41), 178·0. The price of $\frac{3}{4}$in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 17th May) is 45$\frac{3}{8}$d per lb.

U.S. Pump Motor Order

The Denver regional office of the United States Bureau of Reclamation announces the award to the English Electric Export Trading Co. of a $62,000 contract for a large pump motor for the Gila project in Arizona.

Voltage Regulator for Gold Mine

The accompanying picture shows a voltage regulator installed at the Agnes Mine of the Anglo-Vaal Group of South Africa, which was commissioned last month. The regulator was supplied by Brentford Transformers, Ltd., and is of 2,250 kVA capacity operating on an 11 kV 3-phase 50 c/s system. The equipment corrects automatically for 15 per cent drop in the supply voltage and provides up to 12 per cent over compounding to compensate for voltage drop in the outgoing line.



A Brentford voltage regulator at the Agnes Mine of the Anglo-Vaal Group

Record E.C.G.D. Business

The year ending 31st March last was a record one for the Export Credits Guarantee Department of the Board of Trade. Commercial business (under Section 1 of the Export Guarantees Acts) declared as shipped was, at £445·7 million, 14·3 per cent up on the previous year's business (£389·9 million) and exceeded the previous record of £420·9 million for 1951-52.

The face value of policies issued during 1956-57, at £726·0 million, was almost 50 per cent above the previous year's figures and should be reflected in a further increase in business declared in the current year. Short-term and extended-term policies issued (for business up to a maximum credit period of two years) increased in value by 34 per cent, and medium-term policies issued were more than doubled in value. Claims payments increased from £2·3 million in the previous year to £5·4 million—a figure only exceeded in the years 1952-53 and 1953-54 (the years of the heaviest Brazilian claims payments). These heavy claims payments were, however, offset by recoveries of £5·3 million, the highest in any year.

Cyprus Television Station

The island of Cyprus is soon to have its own television service. The Governor of Cyprus, Field Marshal Sir John Harding, has approved plans for a station, to be situated near Nicosia, adjoining the existing sound broadcasting station. The new television service will be entirely equipped with apparatus supplied and installed by Marconi's Wireless Telegraph Co., Ltd., for the Cyprus Broadcasting Service. This will include studio equipment to a value of £23,000, a 500 W vision transmitter, a 125 W sound transmitter and associated

A consignment of motors leaving the works of Brook Motors, Ltd., for the U.S.A.

transmitting equipment. Technicians from Cyprus who will operate the new station are at present being trained in the Marconi works, while the B.B.C. has undertaken the training of programme producers.

Liège Fair

The 9th International Liège Fair, which was held from 27th April to 12th May had for its theme "Applied Science in Industry." There were 450 exhibitors of whom 25 were British. Their products comprised mainly miners' helmets and safety lamps, electrical and hand tools, paint spraying equipment, welding electrodes, cement mixers, conveyor belts, small petrol motors and pumps. One of the principal attractions of the Fair was a festival of British technical films.

Higher Management Lectures

The London Branch of the British Institute of Management is holding a series of higher management lectures on Wednesdays, from 29th May to 26th June, at the Fyvie Hall, The Polytechnic, Regent Street, W.1. The subject will be "Management Through the Next Decade."

Dismantling Liverpool Overhead Railway

It is announced that the contract for the dismantling and removal of the Liverpool Overhead Railway has been awarded to George Cohen Sons & Co., Ltd. The company has been allowed up to two years in which to complete the contract.

Diesel Sets for Pakistan and Iran

The National Gas & Oil Engine Co., Ltd., has received two recent orders from Pakistan and Iran. The first is for two B2AUP6 six-cylinder, pressure charged, dual-fuel engines each developing 1,460 b.h.p. at 333 r.p.m., and each driving a Brush 1,000 kW, 3·3 kV, three-phase, 50 c/s alternator. They are for the Moghalpura power station of the North Western Railway and are due for delivery from the works in November next.

The second order is for two B4AU8 eight-cylinder, pressure charged engines with a continuous site rating of 1,870 b.h.p. at 333 r.p.m. Each engine is coupled to a Brush 1,310 kW, 6·6 kV, three-phase, 50 c/s alternator. These units are due for delivery from the works in September to Sherkate Sahami Electriki Fierouz of Teheran.

George Kent in Thailand

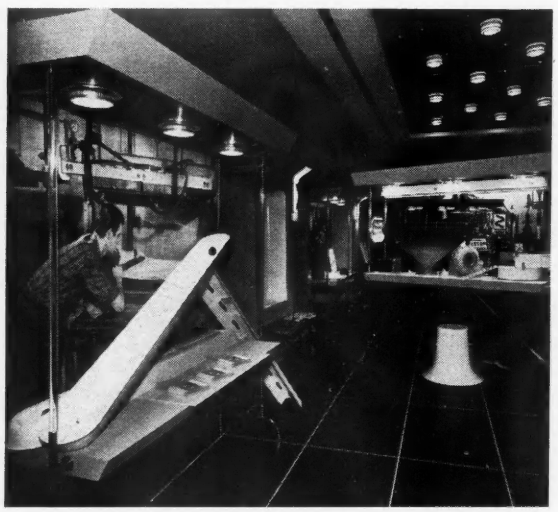
Direct representation has now been established in Thailand by George Kent, Ltd., to meet the growing demand in that country for measuring and control apparatus. A branch office and workshop of George Kent (Malaya), Ltd., just opened in Bangkok offers complete technical facilities, ex-stock deliveries, and service on all Kent equipment. The address is 284/1, Suriwongse Road, Bangkok.

Nigerian Electrical Imports

Figures published in the *Nigeria Trade Journal* show that imports of electrical machinery and apparatus into Nigeria rose in value from £4,666,000 in 1955 to £5,011,000 in 1956. Nevertheless the proportion of electrical to total imports declined slightly—from 3·4 to 3·3 per cent.

Plastics Industry Training Grants

The trustees of the Plastics Industry Education Fund invite applications from young men or women engaged in the plastics industry for a limited number of training grants towards the cost of a year's full-time study at an approved course leading to a degree, diploma or other equivalent qualification in science or engineering, or in industrial design. Approved courses for full-time study include those leading to the associateship of the Plastics Institute, intermediate or final B.Sc., or Dip.Tech. courses in pure and applied mathematics, physics, chemistry or engineering, and diploma courses in chemistry, electrical engineering, mechanical engineering and industrial design. The value of the grants in the past has been normally of the order of £100, but smaller sums will be awarded by the Training Grants Committee when other resources are available to the candidates, and applicants will be expected to have approached their appropriate local education authority for financial assistance. Applications for renewal of grants for a second year will also be considered. Further particulars can be obtained from the secretary to Council, the Plastics Institute, 6, Mandeville Place, London, W.1, to whom applications should be submitted by 13th July.



An exhibition of "Darvic" p.v.c. sheet held recently by Imperial Chemical Industries, Ltd., at Millbank, London, S.W.1

Annual Holidays

Lindsay & Williams, Ltd., Openshaw Bridge Works, Manchester, 11, announce that their works will be closed for production from 8th to 17th June. A skeleton clerical and warehouse staff will be in attendance (except Whit Monday) to deal with inquiries and inward deliveries.

Trade Announcements

Simmonds Aerocessories, Ltd., announce the formation of a new subsidiary company, Firth Cleveland Instruments, Ltd., which will manufacture and market the instruments formerly produced by Simmonds Aerocessories and also take over from the parent company various developments in the general field of instrumentation for aircraft, marine, nuclear and industrial application. Firth Cleveland Instruments will be situated at Treforest, Glamorgan, adjacent to the existing Simmonds factory. The following directors have been appointed:—Mr. C. W. Hayward (chairman); Mr. L. G. Oxford and Mr. E. S. Mead (joint managing directors); Mr. F. R. Allen (executive director and general manager); Mr. S. H. Goss, Mr. P. Pehrson and Mr. D. Broadbent (executive directors).

Holiday & Hemmerdinger, Ltd., wholesale radio and electrical factors, have moved this week to larger premises at 71, Ardwick Green North, Manchester, 12 (telephone: Ardwick 6366). The ground floor of the building contains a large trade counter, showroom and offices, and goods are stocked on the ground floor and two floors above.

FitzGibbon & Murray, Ltd., announce that the sales of their products for Ireland are now being divided up into two territories. Sales in Eire are being handled by McKenna Distributors, Ltd., Corn Exchange Buildings, Burgh Quay, Dublin, and sales in Northern Ireland are being handled by W. N. Lemon & Co., 122, Downshire Road, Holywood, Co. Down.

Bill Switchgear, Ltd., have taken over more extensive premises at 20, Sandyford Place, Sauchiehall Street, Glasgow, C.3. The telephone number (Cen. 0960) is unchanged.

Mr. W. R. Coleman, electrical manufacturers' agent, is now operating from Victoria Buildings, 32, Deansgate, Manchester, 3 (telephone: Blackfriars 3851).

PARLIAMENTARY REPORT

Naval Developments

In the debate on the Navy estimates, Mr. C. Soames, Parliamentary Secretary to the Admiralty, said that the vote for scientific services had been reduced by £1,250,000 by carefully pruning the research and development programme. But the Government had safeguarded the projects of high importance, such as research into new guided weapons and radar equipment, anti-submarine devices and new forms of propulsion, including nuclear propulsion. These would continue on the same scale as last year and provision had also been made for the study of nuclear propulsion for surface vessels.

Mr. Thomas Steele complained that the Navy's development of nuclear propulsion for surface vessels was lagging behind developments in other countries. Major Wall reinforced the plea for faster development of atomic power for ship propulsion and Brigadier Clarke said that with fewer ships to repair and build in the naval dockyards, new nuclear ships should be built there.

Mr. Percy Wells said that for two years the people who worked at Sheerness dockyard had been concerned about the building of a new electrical shop which was urgently required, and the change-over to a.c. Recently the work on this shop, which was far advanced, had been suspended and the change-over had also stopped. New machines had arrived for the re-tooling of a number of shops but the installation had now been suspended.

Mr. T. G. D. Galbraith, Civil Lord of the Admiralty, said that whenever bases or dockyards were to be closed a long warning would be given of the intention, and details of the buildings which could be used for factories would be publicised. As for nuclear development, whatever the signs in public might be, the Government were pressing ahead as fast as they could. They realised its importance and wanted to get marine development as economic as the land side of nuclear engineering. The question of using Portsmouth dockyard for nuclear developments would be borne in mind.

Modernisation in the Army

The modernisation of all the engineering equipment used by the Army is now being carried out, Mr. John Hare, the Secretary of State for War, told the House of Commons during the debate on the Army estimates. He also announced that a new range of radio sets was being taken over by the Royal Signals and other arms which would give a performance greatly superior to those used in the past. They would have a greater range, work well by night and weigh less. In addition, a radio relay signal system was coming into service. It provided a radio telephone link over considerable distances without the need to lay and maintain lines between headquarters.

Mr. P. Goodhart referred to the development of transistor sets and said it would be a pity to introduce at great expense equipment which would all too soon be obsolete. He thought the Ministry of Supply experts were giving too much priority to the more remote schemes for electronic development. It might be desirable to maintain constant radio contact with an artificial earth satellite revolving around the world, but that was not much consolation to a company of men slogging across a mountain range and totally unable to maintain contact with their rear neighbours.

Replying to the debate, Mr. Julian Amery, Under Secretary of State for War, said that the proposed all-Regular Army faced serious technical problems. Under National Service the Army had been able to command the services of the most intelligent young men in every age group. It could not be expected that they would volunteer in the future. Therefore, the Army must seek new methods if they were to have all the technicians who were needed. They hoped to have a good number from the apprentice schools and thus to train their own technicians.

Efficient Use of Manpower

Mr. Iain Macleod, in a statement about the National Joint Advisory Council's inquiry into the efficient use of manpower, said that replies had been received from firms covering about 80 per cent of the employees in British industry. About one-third of the industries reported that they had no serious difficulties over restrictive trade union practices. Of the remainder, the majority had or were about to set up joint machinery for examining the problem. A small number of industries had been unable so far to embark on joint examination of their problems. Generally speaking the replies offered encouraging evidence of the willingness of the employers and the trade unions to discuss and seek satisfactory solutions to the problems of restrictive practices. Joint committees had produced most useful results. He was convinced this was the most fruitful approach to this very difficult problem.

Euston-Glasgow Electrification

Mr. Kenneth Robinson asked the Minister of Transport when the electrification of the Euston-Glasgow main line would commence; which section would be undertaken first; and when it was expected that the Euston-Rugby section would be completed.

Mr. Harold Watkinson replied that the pilot section in Lancashire and Cheshire should be in operation by the middle of 1958, but it was not possible at this stage to say when the section of the line from Euston to Rugby would be ready. It was hoped that the whole line from Euston to Manchester and Liverpool would be completed by 1967. He added that the Euston-Rugby section would be ready a long time before the whole line was completed.

Mr. Popplewell asked whether the progress being made on the modernisation programme was up to expectations.

Mr. Watkinson: "It is a tremendous task and it is actually ahead of schedule."

The Hunterston Inquiry

Referring to the proposed new public inquiry into the siting of a nuclear power station at Hunterston, Mr. Thomson said the technological race for atomic power between the various nations was so intense that any unnecessary delay might be very damaging to Britain. Therefore, why should not Sheriff Leslie simply consider the evidence and submissions already made and completed? Why should there be further delay?

Mr. MacPherson said that the Government realised the great public interest in this project but the fact remained that the procedure at the inquiry was a matter for the person holding it. The Government saw no reason to interfere with the proper conduct of the inquiry.

Night Work by Apprentices

Mr. Frederick Lee asked the Minister of Labour what information he had as to the incidence of night working among engineering apprentices, and the effects of this upon their technical training.

Mr. Robert Carr, Parliamentary Secretary, said that the only information he could obtain would be the numbers of boys between the ages of 16 and 18 years in the engineering industry who did some night work. He knew that the numbers were extremely small and he doubted whether the exact information would be sufficiently useful to justify a special inquiry.

Regarding the special aptitude scheme, Mr. Carr informed Mr. Lee that the object was to ensure that a boy should not be penalised through lack of training facilities in his own area. The allowances were determined after taking account of regular earnings and other income and of necessary expenditure while living away from home.

Training Facilities

Mr. Lee asked what improvements had been granted by employers during

the past few years in the facilities for technical training of apprentices.

Mr. Carr replied that in the industry group comprising engineering, shipbuilding and the manufacture of electrical goods the number of students released by employers for part-time education in technical colleges had risen from 122,000 to 150,000 in the past four years. He understood also that while precise figures were not available, steadily increasing numbers of young people were being sent by their employers on "sandwich" courses in engineering subjects in technical colleges.

Broadcasting Plans

Asked in the House of Commons whether the Government proposed to introduce commercial sound broadcasting, Mr. Marples, Postmaster General, said that the Government had no proposal in mind at present, but it would be considered in any comprehensive review of television and sound broadcasting which might take place.

Mr. Thompson, Assistant Postmaster General, told the House that by the end of the year 98 per cent of the U.K. population would be able to receive B.B.C. television programmes if they had sets. The B.B.C. was seeking approval for a v.h.f. and a television station in the Orkneys. Scotland's third B.B.C. television station and an I.T.A. station would be in operation, all being well, this summer.

Atomic Hazards

Viscount Thurso in the House of Lords asked the Minister of Power whether any statement could be made about the results of the recent study by scientists at Harwell of accident hazards at the atomic power plants now being built, and particularly at the Dounreay plant, in the event of a failure of the cooling system.

Replying, Lord Mills said that the possibility of failure of the cooling system had been one of the fundamental considerations taken into account in designing the fast reactor at Dounreay. The design provided that if cooling were to fail and the fuel melted, the molten fuel would be conducted safely away from the reactor core. The Atomic Energy Authority had studied the worst conditions which could arise from such a failure and was satisfied that there could not be an uncontrolled nuclear reaction. All dangerous material could be adequately contained within the steel pressure sphere surrounding the reactor. The recent work at Harwell was directed towards the behaviour of a melting core in order to achieve greater freedom in core design while continuing to ensure the safety of those in the vicinity.

The Decimal System

Mr. Marcus Lipton asked the President of the Board of Trade whether he would now recommend the adoption of a decimal system of currency and a metric standard of weights and measures as the Hodgson Committee had strongly recommended six years ago.

Mr. Erroll said the Government were not prepared now to recommend the changes suggested in the report but they were noting the arguments which were being put forward, particularly with reference to the proposed Free Trade Area.

Trade with China

The President of the Board of Trade (Sir David Eccles) informed Mr. Allaun that electric generators up to 375 kVA and certain other equipment might be licensed for export to China under the exceptions procedure provided we were satisfied that they were for civilian use.

Mr. Allaun asked if the Minister was aware that because of this embargo our exports of electrical goods to China fell to £150,000 last year, a mere tenth of what they were in 1947. China was about to build in Honan a hydro-electric station bigger than the largest in America, and Sweden and Switzerland were securing very lucrative contracts.

Sir D. Eccles replied that he was aware of the difficulties and they were now being discussed.

Electricity Bill

The House of Lords last week completed the committee stage of the Electricity Bill without any change of consequence in the principles and objects of the Bill. Some Government amendments of a minor and consequential nature were accepted without demur, and the main debate then turned on two proposed new clauses calling upon the electricity authorities to have due regard for the preservation of natural beauty and landscape amenity in the exercise of their functions, and proposing a new code of procedure on application for consent to erect new power stations, and transmission lines.

Government assurances were forthcoming on both counts. Lord Mills, Minister of Power, said that he was as anxious as anyone that in carrying out the power programme, which must be done if the standard of living was to be maintained and improved, they must do their best to ensure that the amenities of the countryside were preserved. He agreed to look into the whole matter, and indicated that he would attempt to deal with it on the report stage.

The second of the clauses, he said, presented some serious difficulties. By laying down, in detail, every step in the procedure of consultation, there was a danger that the boards would be deprived of initiative and discretion. In every case where the local planning authority objected to a project he would agree to order a public inquiry. He was already in the middle of an examination to see what could be done to ensure that interests were consulted at the first possible moment, and not later on when the project might have been formulated. He concluded by stating that he would consider all the arguments put forward. Both new clauses were withdrawn. Forty-three amendments in all were considered, the majority of which, Government amendments excepted, were withdrawn after a brief discussion.

Electricity Supply Training

The Education, Training and Efficiency Committee of the electricity supply industry has recommended a pre-university apprenticeship scheme to provide for school-leavers who satisfy university requirements and have obtained a local authority grant or State scholarship, to postpone their university course for one year. They will spend the year as trainees in the industry. After completion of their degree course, they will return to the industry as graduate trainees for a further year.

The Committee has also recommended a training scheme for commercial officers recruited from new entrants, who will be offered commercial apprenticeships equivalent to student engineering apprenticeships; for sales representatives and some clerical and administrative staff, who will be offered a one-year commercial traineeship; and for engineers trained within or outside the industry, who will also be offered a year's commercial traineeship.

Joint Consultation

To provide for the establishment of joint consultative and advisory machinery in Scotland, as laid down in the Electricity Reorganisation (Scotland) Act, 1954, the 1949 national agreement is to be terminated. There are now to be two agreements: one for England and Wales, and one for Scotland. A new agreement, the National Agreement for Joint Consultation within the Electricity Supply Industry in Great Britain, between the Central Electricity Authority, the North of Scotland Hydro-Electric Board, and the South of Scotland Electricity Board and the ten trade unions, makes provision for reciprocal arrangements and continuous liaison. Each National Advisory Council will nominate a representative Boards' member to serve on the Council of the other, and each representative will be a full member of the Council. Recommendation made by one Council will be considered by the other, and the Councils will exchange minutes and information on matters of common interest.

Electronics, Automation and Instrumentation

Their Impact on Industry, Commerce and Communications

THE proceedings at the conference, which was held in connection with the Instruments, Electronics and Automation Exhibition at Olympia, continued into the second week when medical, industrial, computer and communications and navigation days were arranged. As before, general reviews of the subject each day morning were followed by a paper of a more detailed character in the afternoon.

On Medical Day Professor J. Rotblat said that electronics had provided the physician and surgeon with new and powerful allies. These included the electrocardiograph, which measured the activity of the heart; electroencephalographs, which picked up and analysed the electric impulses from the brain; electro-myographs, which measured the electrical activity in the muscles; and nerve stimulators which were used for the treatment of asphyxia. Descriptions were given of the various instruments involved and their use was illustrated.

On the same day Mr. D. G. Meldrose described the artificial heart-lung in which the problem was not only to imitate the pumping of the blood, but the oxygenisation and removal of the carbon dioxide. This work had been made much easier by the development of electronic measuring devices which could be passed into the heart and pressure relationships thus determined.

A User's Views

On the following day, to which the appellation industrial day had been given, the papers dealt either with instrumentation or fuel efficiency. Speaking as a user Sir Ewart Smith said that what was required was closer collaboration between users and manufacturers based on first hand personal knowledge. Electronic devices were as nearly revolutionary as could be imagined and the analyser and computer would come on to the shop floor as master brains in much of the work done. When that happened limits of reliability in indicating or recording instruments far in advance of anything that had hitherto been reached would be required.

Instrumentation in the paper industry paid dividends, said Mr. B. W. Balls, because it enabled the consistency of the material and its moisture to be controlled, thus leading to reductions in overweight, over-dryness and scrap. Production was increased owing to regularity in machine operation and a reduction in time lost by paper breaks and overheating.

In the textile industry, Mr. J. E. Fielden pointed out, instrumentation enabled them to follow the threads and material during the manufacturing process. One of the greatest faults which had thus been brought to light was cyclic variation in the cloth and some form of automatic control was necessary to solve the related difficulties. In the textile industry the whole process depended on the extrusion of fibres through a series of rollers which were running at progressively faster speeds. Thus the thread was elongated at each operation and the problem was to alter the rotational speed of the shaft to correct this. Mechanical methods, were, however, far too slow.

In the food industry, Mr. A. J. Goodall contended, instrumentation could play a large part in achieving consistent quality while ensuring that the best use was made of raw materials, power and labour. It enabled what was happening in the plant to be ascertained, standard qualities and yields to be produced, wastage, process and labour costs to be cut down, methods to be improved, safety to be increased and high capital cost equipment to be fully utilised. An indirect result under the last-named heading was that instrumentation in conjunction with radioactive isotopes enabled faults in the product to be detected and unacceptable material removed without interrupting the process.

Fuel Efficiency in Industry

Mr. R. Clare pointed out the value of instruments in obtaining fuel efficiency in industry. In order to ascertain the potential fuel savings in a works the measurements must cover both heat production and utilisation; and he gave examples of how this could be done. The needs of fuel efficiency and productivity were complementary and both could only be tackled satisfactorily and completely by the fullest use of measurement and subsequent analysis.

Wednesday, May 15th, was entitled Computer Day, and three papers were presented dealing with the use of this type of equipment in offices, banks and for controlling production. In one of these, Mr. L. Temple said that banks would soon be making full use of computers. All dealing would be stored on a magnetic memory drum and statements would thence be produced on a high-speed printer. Wearisome sorting of large numbers of cheques would be avoided in this way.

Mr. J. W. Grant emphasised the usefulness of the computer in assimilating the problems and integrating all the processes in a factory. By its use it was possible to give advice to each section about the task immediately ahead of it and thus to control production in the most efficient way.

Communications and Navigation

The meetings on the final day were devoted to communications and navigation and opened with a paper on the future by Sir Gordon Radley, which was read in his absence through illness by Mr. A. H. Mumford. During the next sixteen years, he said, radio relay systems of very large capacity, each capable of carrying several hundred telephone channels, were likely to be built. The system would extend from south to north of the country and would carry six independent radio transmissions in each direction, while each of these transmissions would be capable of bearing up to 600 telephone and one television channels. It would be a definite policy for future development that all broadband channels should be interchangeable between cable and radio and be usable for both telephony and television.

Soon subscribers would be able to dial long-distance calls and this facility would also be introduced into call boxes. Ultimately, operators would only be needed at the main switching centres, particularly for international calls. Nation-wide dialling would make it necessary to set up a national numbering scheme and this was being planned for 20 million subscribers on 8,000 exchanges. Ultimately, electronic equipment was likely to replace mechanical equipment in exchanges. The equipment would cost less, it would be smaller, cheaper buildings

would be needed and maintenance should be very greatly reduced.

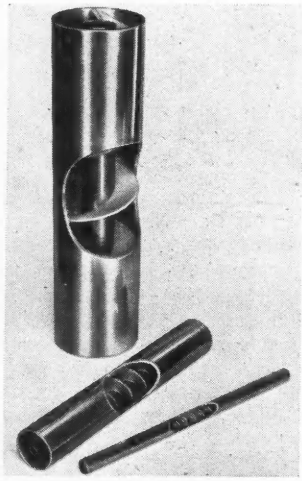
Mr. A. L. P. Milwright described how ships' radar was being made safer and said that in future there would be standardisation of readings so that a pilot going from one ship to another could expect to find the same scales, irrespective of the make of the set. The ranges would be standard at $1\frac{1}{2}$, 3, 6 and 12 miles.

Because the signal on the radar screen from any ship at long range was much the same as that from any other it was often difficult in congested areas to distinguish the right ship from others around it. The Racon—a radar beacon—had been developed to help the mariner. It picked up the radar transmission from the ship and returned it with a characteristic signal which the captain could recognise. It was working on a lightship in the Thames Estuary and at Dungeness.

Submarine Cable Insulation

THE eighth annual lecture of the Plastics Institute was delivered by Sir John Dean (Submarine Cables, Ltd.) on 3rd May at the Institution of Electrical Engineers. His subject was thermo-plastics in the submarine cable industry, the development of which he traced from the introduction into this country in 1843 of gutta-percha from Malaya. The principal use of this natural product had been for insulating submarine telegraph cables, for which it possessed pre-eminent qualities. It was, however, found unsuitable for long telephone cables owing to rapidly increasing electrical losses at the higher frequencies.

After prolonged research dating from the early 1920's, a real advance came from the discovery of polythene as a by-result of investigations by I.C.I. into the effect of extreme pressure on gases. The first experimental length was produced in 1939 at the Greenwich factory of the lecturer's company. Among its earliest applications was to cables having the right low-loss dielectric necessary for connecting radar equipment to its associated aerial, in controlling mine fields and in submarine communications for defence purposes. The meagre supplies then available led to the use of polyisobutylene (P.I.B.), which acted as a plasticiser and enabled the more brittle and sharply melting varieties of polythene to be used. Later, butyl rubber was also used in the same proportion of 5 per cent to improve polythene for submarine cables, particularly in resistance to cracking.



Helical membrane cable with aluminium sheath and polythene insulation, showing range of sizes from 3·125in o.d. to 0·475in o.d.

For jointing polythene an injection moulding technique was necessary, which at the high temperatures employed tended to decentralise the conductor at the shoulders of the joints unless elaborate precautions were taken. The insertion of a polythene repair length in an old gutta-percha cable called for two graded joints, the incompatibility of the two dielectrics being overcome by both being soluble in P.I.B.

Early doubts about the practicability of air-spaced coaxial polythene-insulated cable owing to humidity as a result of internal permeability and diffusion of water vapour were set at rest by tests at the Greenwich laboratories and the subsequent satisfactory functioning of a cable of this type which was laid between Holland and this country in 1948. Another type of air-spacing polythene support, the helical membrane cable, had been devised by the lecturer's company which met the requirements of strength to withstand the great hydrostatic pressure in ocean depths and the strain of laying. The effective dielectric constant of this cable was only 1·8.

Transmission under water at high frequencies was made feasible through amplification of the electrical impulses to their original value for distances that were limited by the voltage that could be safely applied to the cable and the reliability of the amplifiers. Two principal developments which made the transatlantic telephone cable a possibility were the invention and development of polythene and of the submerged repeater [particulars of which were recently given at the I.E.E. and reported in the *Electrical Review* of 1st February].

High-voltage cables insulated with polythene had recently been installed at oil fields in Venezuela, of which 13 miles with further links were run under the surface of a lake. Over each polythene-insulated core was a separate electrostatic screen. Interstitial conductors gave a low-resistance return path for fault currents. A p.v.c. sheath over the armour wires and a compounded jute serving furnished protection against corrosion.

An important variation of the use of air as a dielectric was the increasing application of foamed or expanded polythene for radio frequencies. This could be used in the sea if protected by a metal tube or metal tapes and would no doubt be employed later in providing cheaper low-attenuation communication cables.

Colonial Development Schemes

EIGHT new projects were begun by the Colonial Development Corporation last year, making 66 now in hand. For these schemes capital amounting to £74,201,000 has been approved. This is recorded in the Corporation's annual report for 1956 (H.M. Stationery Office, price 3s), which shows that £27,079,000, or 36 per cent of the total investment approved, was in respect of nine power schemes, one of which was that at Kariba (£15 million approved).

Pointing out that the Corporation's long-term borrowing is limited to an outstanding £100 million, the report says that the approximate capital requirements of new schemes under review amount to £38 million and more credit is now urgently required.

Regarding emergent territories, the report says that last August the Corporation was informed that the Government "had in mind" that no new projects should be started after a colony became independent, and the Ghana Independence Bill included a clause which removed that country from the territories in which the Corporation was to operate. Remarking that there was disappointment in both Ghana and Malaya at the prospect of losing C.D.C. help, the report says "It is surely commonsense that the now established, efficient and profitable C.D.C. should be permitted to invest in emergent territories." The report adds that the word "Colonial" should of course come out of the title. Some details are given of the various projects in hand, the electrical ones being listed below.

Territory	Project	Capital Approved £000
Barbados	Barbados Light & Power Co.	250
Barbados	Potaro Hydro-Electric Co.	392
Dominica	Dominica Electricity Services	225
Jamaica	Jamaica Public Service Co.	300
St. Vincent	St. Vincent Electricity Services	210
Malaya	Central Electricity Board	7,166
Kenya	Kenya Power Co.	3,535
Central Africa Federation	Federal Power Board (Kariba)	15,000
Basutoland	Ox Bow Lake Power & Water (investigation)	1
Total		27,079

Transistor Circuits

APPLICATIONS AND DEVELOPMENTS IN DESIGN

IN an integrating paper presented before the Radio and Telecommunication Section of the Institution of Electrical Engineers Dr. A. G. Milnes (Royal Aircraft Establishment) surveyed developments in junction-transistor circuits and their applications and discussed trends in design. The paper described techniques of overall and local feed-back, to give gain stability with temperature in low power amplifier circuits, and the shaping of gain/frequency characteristics.

For servo-mechanisms, amplifiers of 5 W or more were under development for two-phase motor control. Transistors could be used in voltage and current regulators, sometimes with magnetic amplifiers, and silicon diodes might be used as reference elements. In feed-back oscillators, circuit trends were towards securing amplitude and frequency stability up to one part in 100,000 and low harmonic distortion; three-phase circuits of substantial power outputs were available. Germanium-alloy junction transistors gave nearly ideal switching characteristics. Chopping circuits for millivolt signal levels and high performance demodulators had been devised to operate between −65 deg C and +70 deg C.

The switching properties of transistors were being applied in conjunction with magnetic cores for digital computers, considerably reducing their size; power requirements were less than for thermionic valves by a factor of over 1,000. Transistors were capable of supplanting all thermionic circuits up to 10 Mc/s with currently-available units. High temperatures limited their military application pending wider availability of silicon, and high cost restricted their more general application.

Change in Outlook

Opening the discussion, Dr. E. V. D. Glazier referred to an almost phenomenal change in outlook since 1954, when it was maintained that for digital techniques point-contact transistors were required. Junction transistors, however, were found to meet the temperature and voltage scales. With the digital type of circuit relatively speedy development was possible. With a bench and a box of components, a few tag strips, a battery and a cathode-ray oscillograph a man could start straight away. He did not require to design a chassis and a power pack. It was his opinion that for digital and data-handling techniques the transistor had already ousted the valve. Although this country might be behind America in the production of transistors, particularly of the higher frequency type, British-made transistors had proved most satisfactory, particularly in regard to life and uniformity.

Dr. G. B. B. Chaplin did not entirely agree that transistors were capable of supplanting thermionic circuits in all except high-frequency applications. Their main limitation was low input impedance which meant that small currents, particularly direct currents, could not be amplified. Silicon transistors did not promise much improvement. At the other extreme, he thought very-high-frequency transistors would be available in the immediate future. Applications would be opened up with transistors in pulse circuits, such as digital computer circuits, which had not been possible with valves.

Mr. T. R. Scott agreed with the author's views but felt that reference should have been made to symmetrical transistors. In some applications of data processing and combinations of magnetic and transistor applications they were real time savers.

Noise Problem

Mr. A. J. W. M. Overbeek (Netherlands) said that while transistors could now be used to advantage in nearly all fields of electronics, transistor circuit design was in some important respects not well established yet. Noise was a major problem and another problem was that at high switching frequencies transistors might show memory properties with time constants that were too long to be attributed to classical minority carrier storage. On the other hand, there were one or two promising developments not mentioned in the paper, such as the use of a combination of p.n.p. and n.p.n. transistors and the use of two transistors in a cascade circuit at high frequencies.

Mr. R. A. Hilbourne remarked that people were no longer looking for applications in which they could use transistors but were looking for transistors to suit their particular applications. He felt that more attention should have been paid in the paper to entertainment as compared with industrial and power type applications. While there was an important future in the latter, manufacturers would for some time have to look to the entertainment market as an outlet for much of their product.

Telephone Exchange Control

Mr. Heetman said that the transistor was providing a key to control in certain telephone exchange applications where subscribers could not be given a satisfactory service with the selectors now in use.

Mr. W. L. Stephenson used a number of equations to illustrate the claim that symmetrical transistors were not necessarily faster in switching.

Mr. J. W. Barry commented that certain aspects, such as regulator circuits, computers, magnetic amplifiers and so on, had been covered in considerable detail, and this was a good thing, particularly as there was little about them in the literature. He too thought more space should have been devoted to the entertainment field, including gramophone amplifiers and radio receivers. Television applications also were becoming important as regards power in the light of recent advances.

Mr. L. C. Morgan did not entirely agree that the fundamental principles of transistor circuit design and operation were well established. This was borne out by the number of parameters, the measurement of which was now under consideration.

Dr. A. J. Biggs said the idea of progress being to think only in terms of transistors seemed to him disgraceful. In future instead of asking applicants for a job what they knew about transistors they should be asked what they knew about thermionic valves.

Dr. E. L. C. White put in a plea for the supply of n.p.n. transistors: there did not seem to be any in this country.

Mr. A. R. Owens held that the n.p.n. was not needed at all and illustrated his point by means of diagrams on the blackboard.

I.E.E. ANNUAL REPORT

Further Increase in Membership

THE annual report of the Institution of Electrical Engineers for 1956-57, which was presented at the eighty-fifth annual general meeting of the Institution yesterday (Thursday), indicates that the rate of increase in membership has been well maintained; in fact, a record number of applications was received during the year. The total now exceeds 41,000 of whom more than 22,000 are corporate members. During the year 5,745 applications for election or transfer were dealt with by the Membership Committee. The number in 1955-56 was 4,814, the previous highest total of 5,282 having been attained in 1948-49. The number of members elected during the year was 2,681, compared with 1,978 in 1955-56. The total number of corporate members now exceeds 22,000 and the number of graduates increased during the year to 12,652. The number of associate members who have transferred to full membership again compares favourably with previous years. Two women were admitted to associate membership during the year making 28 in all and a total of 72 for all classes of membership.

The Council elected Sir Noel Ashbridge (past-president) to honorary membership of the Institution. Using special powers, Brigadier-General Sir Harold Hartley was also elected an honorary member and the thirty-fifth award of the Faraday Medal was made to Dr. Waldemar Borgquist, lately president of the Swedish State Power Board.

During the year 1,365 meetings of members, the Council and various committees were held in London and at the local centres. Twelve ordinary meetings were held in London, with an average attendance of 290 as compared with 310 for the previous year. Of these, one was a joint meeting, linked by the transatlantic telephone cable with the American Institute of Electrical Engineers and the Engineering Institute of Canada at which the engineering of the cable project was reported and discussed. A number of joint meetings with the Institution of Civil Engineers and the Institution of Mechanical Engineers were also held. The work of the specialised sections continues to increase and there has been a corresponding increase in membership, as will be seen from the accompanying table:—

	Membership at 31st March, 1957	Number of meetings	Average attendance (figures for last year in brackets)
Measurement and Control ..	2,825	15	71 (61)
Radio and Telecommunication	5,419	14	197 (152)
Supply	4,976	9	141 (147)
Utilisation	4,367	8	115 (120)

During the year 534 meetings of a general character were held by the ten local Centres and their Sub-Centres and specialised groups. In addition, a number of social functions were held at several of which the president was present, accompanied by the secretary. The vice-presidents visited all twenty-one Centres and Sub-Centres and also deputised for the president at social functions which he was unable to attend. The Council has set up a special study committee to examine the service which the present structure of local Centres and Sub-Centres provides for members in the provinces and to make recommendations for the future in the light of experience gained in operating the present system and having regard to the steadily increasing membership. Their report is under consideration by the General Purposes and Local Centres Committees of the Council.

Three successful conventions have been held on "Digital Computer Techniques," "Ferrites" and "The Electrical Equipment of Aircraft," each of which was attended by many visitors from overseas, and a convention on micro-wave valves is being planned for 1958. The Government's Report on Scientific and Engineering Manpower in Great Britain has been carefully studied by the Council. Measures to stimulate recruitment to the electrical engineering profession have been continued and attention is now being focused on recruitment of girls as well as of boys to meet the country's needs for professional engineers. The work of the National Council for Technological Awards has been followed with interest. Its award for engineering studies will be designated Dip.Tech.(Eng.) to distinguish it from Dip.Tech., the award which applies to other technologies, a decision greatly welcomed by the Council.

The possibility of embarking upon a major scheme for a new building has been constantly under examination for a long period, but in view of the exceptionally high cost of such a project under existing economic conditions, it is now felt that it would be advisable instead to carry out a limited modification of the existing building in order to meet present demands and increased requirements in the future. The Joint Building Sub-Committee of the Finance and General Purposes Committees have been investigating this problem and as soon as a satisfactory scheme has been prepared full particulars will be given.

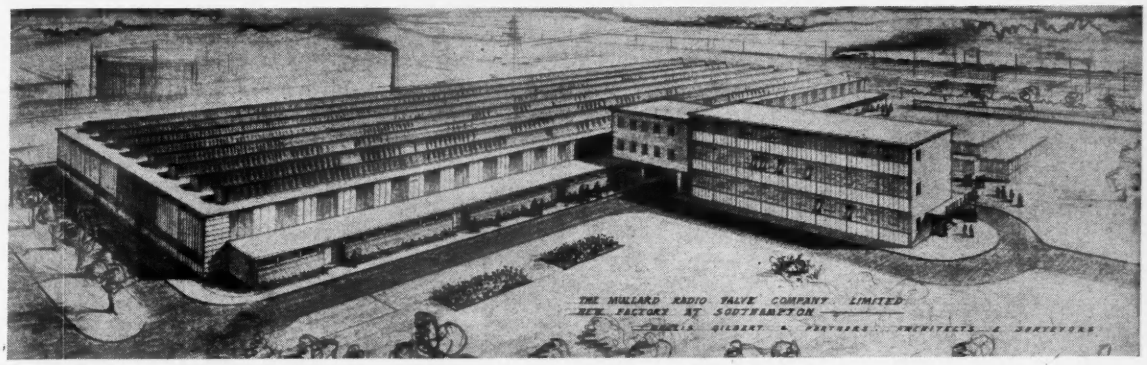
Met-Vick Easter School

AN "Easter School" for headmasters and science masters was organised by the Education Department of the Metropolitan-Vickers Electrical Co., Ltd., at Trafford Park from 29th April to 1st May. This was the sixth in the company's series of Easter and Summer Schools. About a hundred representatives from some sixty public and grammar schools, including girls' schools, attended. Among those present were Mr. B. G. Robbins, secretary of the Institution of Mechanical Engineers, Mr. N. C. Stamford, education officer of the Institution of Electrical Engineers, Mr. H. J. Shelley, H.M. Chief Inspector for Further Education, and Mr. D. G. Chambers, general secretary of the Public Schools Appointments Bureau.

After being welcomed by Dr. Willis Jackson, director of research and education, members heard a lecture on the company by the chief electrical engineer, Mr. C. H. Flurscheim. The visitors were then conducted round some of the main manufacturing departments of the works. In the evening they were entertained by the College and School Section of the Apprentice Association.

The second day was devoted to the research and educational activities of the company. In a lecture on "New Developments in the Engineering Industry," Dr. Jackson discussed the developments in the electrical industry over the past thirty years, particularly relating to the power output of generating plant. He outlined the part the company was playing in nuclear research and discussed in some detail the new materials which were now available to the engineer. Following this lecture, members were able to visit sections of the company's research establishment. In the afternoon, Mr. R. F. Marshall, manager of the Education Department, explained to members the various types of training courses open to boys and girls within the company, leading to professional status in electrical and mechanical engineering.

On the final day of the school members were able to learn more about the departments of particular interest to them and several discussion groups were arranged.



Artist's impression of the completed Mullard semi-conductor factory

SEMI-CONDUCTOR MANUFACTURE

NEW MULLARD WORKS AT SOUTHAMPTON

WHEN we visited the Southampton works of Mullard, Ltd., last week, we saw the first stage of a long-term project for the establishment of a completely independent manufacturing centre for semi-conductors. When complete, this plant will be the largest single mass production unit for semi-conductors. It is to operate as a self-contained centre containing research, development and application laboratories, and, in addition, has its own tool room, drawing office, library, etc. Basic research will continue to be undertaken at the central Mullard research laboratories.

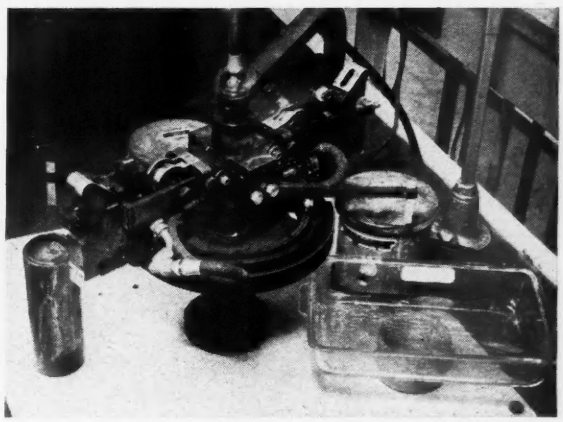
So far, only about one-third of this new plant has been completed. Employment will eventually be given to between 1,500 and 2,000 people. The present staff is about 400, which includes 60 graduates, of whom six are women.

Production of semi-conductors at the moment is still undertaken elsewhere in the company, but this will be concentrated at the Southampton factory in due course. The production programme is based on an estimated output of several million semi-conductor devices of all kinds for 1958, of which a considerable proportion will be transistors.

An extremely high level of purity is called for in germanium used for transistors. The degree of purity is, in fact, probably higher than in any other manufactured article. At one stage of manufacture a purity of one part in 100,000,000 is required—a standard so high that it can be measured only by its electrical effects, and far beyond the scope of chemical analysis.

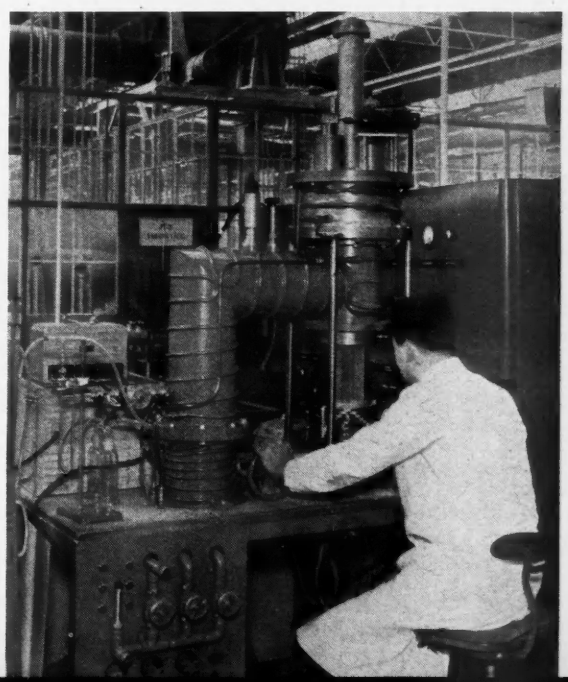
The germanium is purified by a process known as zone-refining, using heat induced in it by an r.f. generator. An ingot of germanium is loaded into a graphite "boat," which travels through a silica tube. A series of r.f. inductor coils gird the tube at intervals along its length, and as the graphite boat passes along the tube each coil produces a molten zone in the germanium. Since the solubilities of any impurities present are greater in liquid than solid germanium, the impurities collect in the molten zones, and as the ingot travels through the successive coils, are swept to the end of the ingot, where the final piece is discarded.

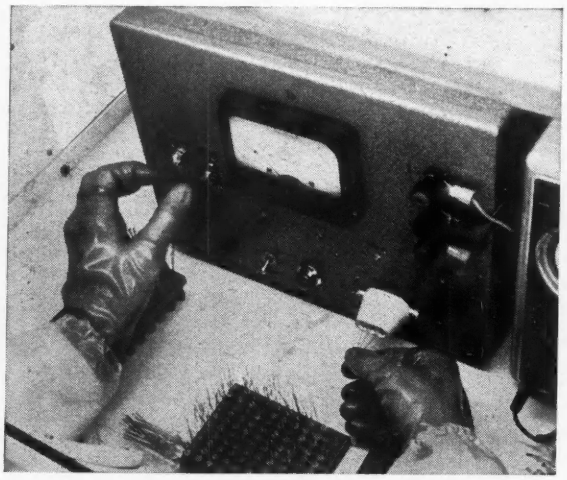
After purification, an ingot of the semi-conductor material consists of many small crystals of differing sizes and orientation. Before it can be used for transistors, the



Rotary machine for tinning the ends of the fine wires forming connections to the base, collector and emitter of the transistor

This equipment is used to grow rods of single crystal silicon





Transistor assembly complete with glass foot and connecting wires being pre-tested for electrical characteristics prior to insertion in its glass envelope ready for sealing

ingot must be transformed into a single large crystal. This is done by mounting the ingot in a silica boat, along with a short length of single crystal germanium which is used as a " seed." The loaded boat is then placed in a furnace and the region of contact between seed and ingot melted. By moving the boat slowly through the furnace the molten region is extended along the ingot, the original seed crystal growing behind it, so that eventually the ingot consists entirely of a single crystal.

Transistor germanium must have a certain value of resistivity, depending on the particular type of transistor for which it is intended. Resistivity is governed by the amount of impurity contained in the ingot, and a calculated quantity is therefore added during this levelling process.

The next step is to machine the single-crystal ingot into wafers of suitable size and shape. First, the bar is cut into very thin slices by a fast-rotating cutting wheel. The slices produced in this way have a thickness of about 0·5 mm, whereas the final thickness required is 0·15 mm. Part of the surplus is removed by grinding, and part by etching at a later stage. Before the etching process takes place, the slices (now about 0·25 mm thick) are cut into dice approximately 2 mm by 2 mm.

After etching to obtain the required final thickness, the dice of germanium are then ready to receive the pellets of indium which constitute the emitters and collectors. These are alloyed to either face of the germanium in a multi-stage furnace containing a controlled gaseous atmosphere. For the alloying process the indium pellets and germanium wafers are loaded into carbon jigs.

The alloyed dice are mounted on glass bases, ready for the nickel connecting wires to be attached, and are then etched in a chemical solution to remove surface contamination, before being pre-tested and having their envelopes fitted. The connecting wires are first tinned on an ingenious rotary machine developed by Mullard plant engineers, and then soldered to base, collector and emitter. A stream of hot gas is used for soldering, the operation being extremely critical and requiring the use of optical aids to ensure accuracy.

The transistors are now ready for their envelopes. These contain a special grease which protects the transistors from moisture, and the encapsulating process is done in a special controlled-humidity chamber. Finally, the finished transistors are subjected to a series of exhaustive tests to ensure their high quality and reliability.

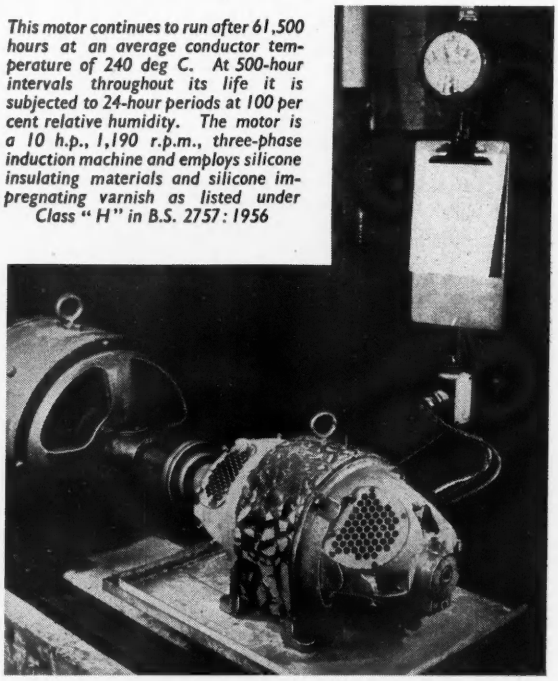
Silicones in Electrical Insulation

DETAILS of tests carried out on silicone and Class " B " insulated motors by their American associates, the Dow Corning Corporation, have been announced by Midland Silicones, Ltd. The programme began in 1943, as a joint project of Dow Corning and Westinghouse Electric. Of eight 10 h.p. 1,190 r.p.m., three-phase induction motors, fitted with special end-bells and asbestos shields to isolate the bearings, six were insulated with silicone bonded and impregnated materials and two with Class " B " insulation.

All eight motors were generator loaded to produce average copper temperatures ranging from 200 to 310 deg C. The operating time was divided into heats, each a 25th of the motor's estimated maximum life. The heats were alternated with 24-hour conditioning periods of 100 per cent relative humidity. An abrupt drop in wet insulation resistance—the point at which crazing appeared on the varnished surface —would be taken as " minimum life." Actual insulation failure would be " maximum life."

Both Class " B " units did fail and catch fire just about as expected, and the silicone insulated motors showed an abrupt drop in wet insulation resistance at the predicted times as well. Contrary to expectations, the drop was not followed closely by total insulation failure. The 310 deg motor, which was expected to fail within a week, and one of the 300 deg motors lasted over seven months. When they did finally break down it was due to copper oxidation.

It was six years before a final report could be made to the A.I.E.E. (*Transactions*, 68, 1133-8 (1949)), and even then the two 240 deg motors were still running. But the practical usefulness had been demonstrated and the A.I.E.E. had already recognised it as Class " H " (high temperature).



This motor continues to run after 61,500 hours at an average conductor temperature of 240 deg C. At 500-hour intervals throughout its life it is subjected to 24-hour periods at 100 per cent relative humidity. The motor is a 10 h.p., 1,190 r.p.m., three-phase induction machine and employs silicone insulating materials and silicone impregnating varnish as listed under Class " H " in B.S. 2757: 1956

Teachers for Technical Colleges

RECOMMENDATIONS ON SUPPLY AND TRAINING

THE report of the Special Committee under the chairmanship of Dr. Willis Jackson, appointed by the Minister of Education in September last to consider the supply and training of teachers for technical colleges, is now available from H.M. Stationery Office (price 4s net). The term technical college as used in this report covers those establishments of further education, other than art establishments, which carry on day work, together with those departments in art establishments in which courses of a technical character such as architecture or printing are undertaken. It does not cover evening institutes, centres of adult education or secondary technical schools.

The report says it has been generally recognised since the publication of the Government's White Paper on Technical Education in February, 1956, that if the expansion envisaged in student members in the technical colleges is to be achieved there must be a considerable increase in the number of suitably qualified teachers. The main objectives of the White Paper are to increase the annual output from advanced courses from 9,500 to 15,000, and to raise the number of students attending part-time day courses during working hours from 355,000 to twice that figure, this programme of expansion being associated with an increased building programme, the last projects of which are to be begun by 1960-61.

The present teaching staff in the technical colleges consists of about 11,000 full-time and 40,000 part-time teachers and nearly two-thirds of the teaching work is carried out by the full-time staff. Of these, about 60 per cent have university degrees or the equivalent: just over half are engaged in teaching science and technology: about one-third have received professional training as teachers, most of them being teachers of subjects other than technology. By 1960-61 the colleges estimate that they will need 7,000 more full-time and 8,000 more part-time teachers, to carry out an increase in the teaching work, compared with the present, of roughly one-half. It is estimated that the average net annual increase in the number of full-time teachers over the next five years will have to be about 1,400.

The Committee feels that the success of the recruitment campaign will depend on three factors: a willingness to develop unconventional sources of recruitment; the establishment of a closer partnership between colleges and industry; and a determined effort on the part of all concerned to raise the status of technical teachers and the attractiveness of their calling.

Late Entrants

With regard to late entrants, the report states that one possible field of recruitment which may not have been adequately explored is the Services. There are in the Services to-day a large number of people with qualifications as a result of service training. For example, Army officers can get external degrees in engineering at Shrivenham, and the naval engineering officers' course is recognised for exemption from the examinations of the Institution of Mechanical Engineers. Moreover, many of the education officers which all three Services employ are graduates. The technical instructor officers in both the Royal Navy and Royal Air Force increasingly possess civilian technical qualifications. In addition, there are a number of service training schemes in the technical field for the higher level of non-commissioned officer, and there is now a growing tendency in all three services to fit their training schemes to the demands of civilian qualifications such as National Certificates. The majority of these technical personnel have good personality, and usually leave the services at an age when they could do at least 15 years of useful teaching.

The level of salaries in the technical colleges is now such as to prove an incentive. At a time when the requirements of the Services seem likely to be reduced the Committee consider there is a need for positive steps to ensure that all technically qualified regular officers and servicemen are made fully aware of the opportunities in technical education, of the nature of the work and conditions of service, and of the fact that training is available if they wish to take it.

Another possible source of recruits is to be found in the Scientific Civil Service and the research associations. There is some evidence that a certain proportion of the highly qualified graduates who enter this type of work find that their effectiveness as research workers declines as their interests change, and that their abilities would find more advantageous outlets elsewhere. Arrangements should be devised to make such men and women aware of the opportunities open to them to make a career in technical teaching, and everything possible should be done to make the transition an easy one.

Training of Teachers

The report states that a knowledge of the subject to be taught is essential, but it is far from being the only requirement: techniques of teaching and of class management are not mechanical routines which can be acquired without an understanding of the principles on which they are based. Evidence has made it clear that the techniques of teaching in technical colleges can be much improved; that many teachers need guidance on the manner in which they should organise and present their subject and advice about the difficulties commonly encountered by their students; and that many of those who have been in industry for a number of years need some introduction to the more personal work of teaching.

It would be impracticable in present circumstances to require all teachers in technical colleges to train. But it is desirable that an increased proportion of those engaged in teaching students at the less advanced levels should have received training; and it would be all to the good if more of the senior staff had done so. The report states that many different types of training course must be made available to suit the varying circumstances of the teachers.

Finally, the Committee considers that the Minister should be recommended to set up an advisory committee on the supply and training of teachers for further education whose duty it would be to review the arrangements and provisions for training and to keep in touch with the technical colleges about the supply of teachers and the demand for different types of training courses. This advisory committee would bring together the local education authorities, the training colleges, industry and commerce, the teachers and the area training organisations.

DOMESTIC ELECTRICAL EQUIPMENT

Refrigerators

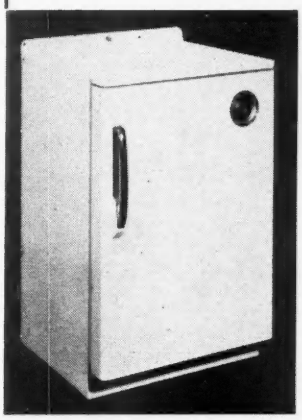
PROBABLY the most notable innovation in refrigerator design during the past twelve months has been the tendency to use coloured finishes on an appliance which has always been traditionally white, or possibly cream. Colour is now being increasingly used on the interchangeable parts, i.e. table tops, plinths, shelves, and the interiors are available in such attractive pastel colours as blue, pink, green and beige.

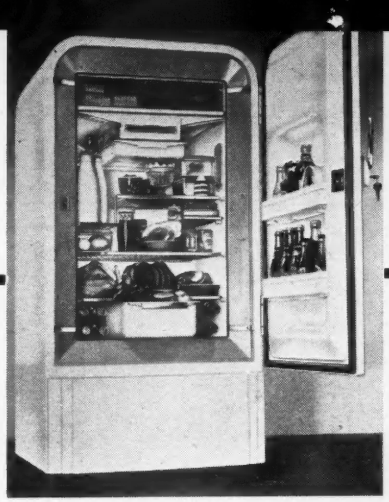
Refrigerators are now no longer regarded as a summer-time investment only but are in use all the year round. This is no doubt due to the growth in the popularity of frozen foods, and many more manufacturers are providing frozen food lockers, or deep freeze compartments, in the new season's models. More use is being made of the inside door area for bottle storage, egg racks, butter compartments, etc. Such refinements as interior lights, cocktail-size ice-cube trays, butter conditioners, salad crispers, meat tenders and hydrators are all to be found in the larger models, but, owing to the restricted space available in a large number of kitchens, the models most in demand are those with a capacity of up to about $3\frac{1}{2}$ cu ft. Their convenient size enables them to be incorporated in kitchen units and, being fitted with a table top, they also provide a useful working surface.

Morphy-Richards, Ltd., have recently added a larger model to their "Astral" range, the 4 cu ft "Commodore," and Philco (Great Britain), Ltd., have entered the refrigerator market with an 8 cu ft model. A 3·1 cu ft refrigerator, the MY-31T, introduced by Frigidaire, Ltd., fits into the smallest kitchen (it can also be built-in) and has left- or right-hand door opening, a choice of five colours, and a 7 lb frozen food locker.

As an indication of the scope for increased sales, it is of interest to note that, according to the Domestic Refrigeration Development Committee, only 8 per cent of the homes in this country have a domestic refrigerator whereas in America the figure is greater than 90 per cent. The main reasons given are the present hire-purchase restrictions and the fact that they bear 60 per cent purchase tax.

Manufacturer	Model	Type	External Dimensions (height, width & depth in inches)	Capacity	Shelf Area	Ice Capacity	Salad Crisper	Frozen Food Chest
COLDETTE REFRIGERATION, 11, Dafforne Road, London, S.W.17.	"Coldette"	Absorption	35×21×23	3 cu ft	5·5 sq ft	24 cubes	No	Yes (in ice box)
CROWTHORN ENGINEERING CO., LTD., Frozt-ed-aer Works, Reddish, Stockport.	"Aristocrat" Mk. III	Compressor	51×24×25	5 cu ft	8 sq ft	2 lb	Optional extra	Yes
	"Autocrat" Mk. I	Compressor	56×28×25	7½ cu ft	12 sq ft	2 lb	Optional extra	Yes
C.S.A. INDUSTRIES, LTD., Wharf Street, Warwick.	"English Rose" ER.50	Compressor	36×42×22	4 cu ft	7½ sq ft	1½ lb	No	Yes
	"English Rose" ER.92	Compressor	66×21×22	5½ cu ft	10 sq ft	1½ lb	No	Yes
	"English Rose" ER.93	Compressor	36×21×22	3 cu ft	6 sq ft	1½ lb	No	Yes
EASICLENE PORCELAIN ENAMEL (1938), LTD., Darlaston, South Staffs.	"Easiclene" 4200	Compressor (sealed system)	38×24×25	4·2 cu ft	8·3 sq ft	18 cubes (1 tray)	Yes	Freezer may be used
ELECTROLUX, LTD., 153-5, Regent Street, London, W.1.	L.230	Absorption	$36\frac{1}{4}\times21\frac{3}{4}\times23\frac{3}{4}$	2¼ cu ft	5 sq ft	14 cubes (1 tray)	No	No
	L.500	Absorption	$53\frac{1}{2}\times26\frac{3}{4}\times27\frac{1}{4}$	5 cu ft	9¾ sq ft	64 cubes (4 trays)	Yes	Yes
	L.730	Absorption	$60\times30\frac{1}{2}\times27\frac{3}{4}$	7¼ cu ft	14 sq ft	80 cubes (5 trays)	Yes	Yes
ENGLISH ELECTRIC CO., LTD., East Lancashire Road, Liverpool, 10.	EA.750I	Compressor	$57\frac{3}{8}\times28\frac{3}{4}\times25\frac{7}{8}$	8·3 cu ft	12·2 sq ft	2 lb	Optional extra	0·58 cu ft U-evaporator
	EA.83	Compressor	$57\frac{3}{8}\times28\frac{3}{4}\times25\frac{7}{8}$	8·3 cu ft	15·2 sq ft	2½ lb	Yes (two)	0·8 cu ft full-width evaporator
FRIGIDAIRE DIVISION OF GENERAL MOTORS, LTD., Stag Lane, Kingsbury, London, N.W.9.	MY-31T	Compressor	$35\frac{3}{8}\times21\times21$	3·1 cu ft	5·3 sq ft	40 "Conettes" per freezing	No	Yes (7 lb)
	MT-44T	Compressor	$35\frac{3}{4}\times24\frac{3}{16}\times24\frac{3}{8}$	4·4 cu ft	8·6 sq ft	18 cubes	No	Yes (10 lb)
	MT-44A	Compressor	$35\frac{3}{4}\times24\frac{3}{16}\times24\frac{3}{8}$	4·4 cu ft	8·6 sq ft	18 cubes	No	Yes (10 lb)

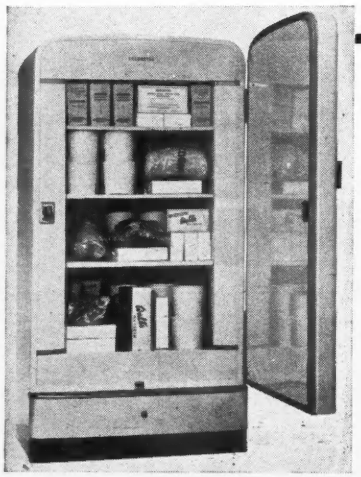




1. *Easiclene "Family Larder" refrigerator*
2. *Electrolux L.500 refrigerator*
3. *English Electric EA.83 refrigerator*
4. *Coldette Refrigeration oak cabinet model*

Interior Light	Special Features	Motor	Element Loading	Finish	Price (excl. tax)	Purchase Tax
No	Oak wooden cabinet	—	150 W	Medium or light oak	£45 0 0 (plus £2 2s service fee)	£19 18 0
Optional extra	D.c. models available	⅛ h.p.	—	Vitreous enamel interior, white or cream exterior	£80 0 0	£37 8 10
Optional extra	D.c. models available	⅛ h.p.	—	Vitreous enamel interior, white or cream exterior	£90 0 0	£42 2 5
No	Designed and styled to match other "English Rose" kitchen furnishings	⅛ h.p.	—	Cream, sea-green or white cabinet. Stainless steel or "Formica" top	£127 10 0	£59 5 8
No	Designed and styled to match other "English Rose" kitchen furnishings	⅛ h.p.	—	Cream, sea-green or white	£78 0 0	£36 5 5
No	Designed and styled to match other "English Rose" kitchen furnishings	⅛ h.p.	—	Cream, sea-green or white cabinet. Stainless steel or "Formica" top	£53 0 0	£24 12 11
Yes	Moulded Polystyrene door panel with built-in butter conditioner and two large capacity shelves	⅛ h.p.	—	Polystyrene moulded interior, stoved-enamel cabinet, porcelain-enamel "table-top." Various colours	£55 0 0	£24 15 0
No	2 door shelves, flexible ice-cube releaser	—	140 W	White or cream	£41 18 0	£19 0 0
Yes	2 door shelves, flexible ice-cube releaser, 4 food containers	—	300 W	White or cream	£80 18 3	£36 13 9
Yes	3 door shelves, flexible ice-cube releaser, 4 food containers	—	350 W	White or cream	£101 17 4	£46 3 8
Yes	Two door shelves	⅛ h.p.	—	Cream or white, doors in three pastel shades	£89 0 0	£39 1 0
Yes	Full width "Coldrawer," 3 door shelves	⅛ h.p.	—	Cream or white, doors in three pastel shades	£100 12 0	£44 2 9
No	Two door shelves and egg rack, left or right hand door opening, work table top	⅓ h.p.	—	Interior: Acid resistant porcelain-on-steel. Exterior: Plastic based synthetic enamel. Five colours	£45 11 8 (plus £2 service fee)	£20 13 4
No	Two door shelves, left or right door opening, work table top	½ h.p.	—	Finish as MY–31T. Colours: Snowy White or Cotswold Cream only	£54 5 0 (plus £2 service fee)	£24 12 0
No	As above but without work table top	½ h.p.	—	As above	£52 16 1 (plus £2 service fee)	£23 18 11

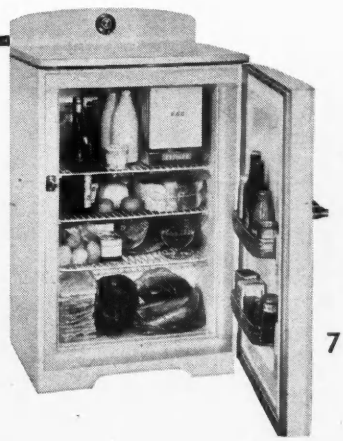
Manufacturer	Model	Type	External Dimensions (height, width & depth in inches)	Capacity	Shelf Area	Ice Capacity	Salad Crisper	Frozen Food Chest	Interior Light
FRIGIDAIRE DIVISION OF GENERAL MOTORS, LTD., Stag Lane, Kingsbury, London, N.W.9. (continued)	DT–44T	Compressor	35⅜ × 24 9/16 × 24⅝	4·4 cu ft	8·6 sq ft	36 cubelets	Yes	Yes (10 lb)	Yes
	DT–44A	Compressor	35⅜ × 24 9/16 × 24⅝	4·4 cu ft	8·6 sq ft	36 cubelets	Yes	Yes (10 lb)	Yes
	DY–84	Compressor	54½ × 27½ × 27¾	8·4 cu ft	15 sq ft	14 cubes 36 cubelets (2 trays)	Yes	Yes (40 lb)	Yes
	MY–88	Compressor	54½ × 27½ × 27¾	8·8 cu ft	16·2 sq ft	14 cubes 36 cubelets (2 trays)	Yes	Yes (19½ lb)	Yes
	DY–101	Compressor	62¼ × 27½ × 27¾	10·1 cu ft	17·8 sq ft	14 cubes 36 cubelets (2 trays)	Yes	Yes (40 lb)	Yes
	MY–105	Compressor	62¼ × 27½ × 27¾	10·5 cu ft	19·8 sq ft	14 cubes 36 cubelets (2 trays)	Yes	Yes (27½ lb)	Yes
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.	DE.41A	Compressor	36 × 23 × 25⅝	4·2 cu ft	7·7 sq ft	1·4 lb (1 tray)	No	Yes	Yes
	DE.81B	Compressor	53 11/16 × 27 13/16 × 28 1/16	8·1 cu ft	15·2 sq ft	2·8 lb (2 trays)	Yes (two)	Yes	Yes
THE HOTPOINT ELECTRIC APPLIANCE CO., LTD., Crown House, Aldwych, W.C.2.	"Coldrator" CT.33	Compressor	36 × 21 × 21	3·3 cu ft	6·1 sq ft	20 cubes (1 tray)	No	No	No
	"Coldrator" CT.36	Compressor	36 × 21 1/16 × 21	3·6 cu ft	6·9 sq ft	20 cubes (1 tray)	No	Yes	No
	"Coldrator" CT.50	Compressor	36 × 24¼ × 24	5 cu ft	9·1 sq ft	40 cubes (2 trays)	No	Yes	Yes
	"Coldrator" CS.81	Compressor	55¾ × 28 × 25¾	8·1 cu ft	14·6 sq ft	40 cubes (2 trays)	2 salad bins	Yes	Yes
	"Coldrator" VF.54 (Home freezer)	Compressor	53½ × 27½ × 24½	5·4 cu ft	8 sq ft	Deep freeze	—	—	No
	"Hotpoint" H.50 (Armoured plate glass table top. Vitreous enamel table top)	Compressor	36 × 24¼ × 24	5 cu ft	9·1 sq ft	40 cubes (2 trays)	No	Yes	Yes



5

5. *Hotpoint "Coldrator" VF.54 home freezer*
6. *Hotpoint H.50 refrigerator*
7. *G.E.C. DE.41A 4·2 cu ft model*

6



7

Interior Light	Special Features	Motor	Element Loading	Finish	Price (excl. tax)	Purchase Tax
Yes	Two door shelves and butter compartment, left or right door opening, work table top	$\frac{1}{1\frac{1}{2}}$ h.p.	—	Finish as MY–31T. Five colours	£59 6 2 (plus £2 service fee)	£26 17 10
Yes	As above but without work table top	$\frac{1}{1\frac{1}{2}}$ h.p.	—	Finish as MY–31T. Five colours	£57 17 3 (plus £2 service fee)	£26 4 9
Yes	Removable butter and cheese compartments, 3 egg-servers, full-width " Picture-Window " hydrator in door, 2 " Roll-To-You " basket shelves, door lock with 2 keys	$\frac{1}{8}$ h.p.	—	Finish as MY–31T. Five colours	£111 7 11 (plus £4 service fee)	£50 10 1
Yes	Removable butter and cheese compartments, 2 egg-servers, full-width " Picture-Window " hydrator in door, meat tender, 2 " Roll-To-You " basket shelves, door lock with 2 keys	$\frac{1}{8}$ h.p.	—	Finish as MY–31T. Five colours	£99 16 8 (plus £4 service fee)	£45 5 4
Yes	Removable butter and cheese compartments, 3 egg-servers, full-width " Picture-Window " hydrator in door, 2 " Roll-To-You " basket shelves, door lock with 2 keys	$\frac{1}{8}$ h.p.	—	Finish as MY–31T Five colours	£138 2 6 (plus £4 service fee)	£62 12 6
Yes	Removable butter and cheese compartments, 2 egg-servers, full-width " Picture-Window " hydrator in door, meat tender, 2 " Roll-To-You" basket shelves, door lock with 2 keys	$\frac{1}{8}$ h.p.	—	Finish as MY–31T Five colours	£126 11 4 (plus £4 service fee)	£57 7 8
Yes	" Turnaround " top shelf, door racks	$\frac{1}{8}$ h.p.	—	Gleaming white or honeysuckle	£56 17 5 (including service fee)	£24 17 7
Yes	Extra large freezer, door racks, butter compartment	$\frac{1}{8}$ h.p.	—	Gleaming white or honeysuckle	£101 2 0 (including service fee)	£43 16 0
No	Ice-blue enamelled shelves, freezer and chiller dish, plastic table top	$\frac{1}{10}$ h.p.	—	White or cream stoved enamel	£50 9 5	£21 19 7
No	Two ice-blue enamelled shelves, 1 small folding shelf, freezer and chiller dish. Bacon keeper, egg rack and bottle shelf in door	$\frac{1}{10}$ h.p.	—	White or cream stoved enamel, table top in white, cream, blue, green or red vitreous enamel £2 16 7 extra plus 6s 5d tax	£51 3 11	£22 6 1
Yes	Two ice-blue enamelled and 1 plate-glass shelves, freezer and chiller dish. Butter compartment, egg rack and bottle shelf in door	$\frac{1}{10}$ h.p.	—	White or cream stoved enamel, table top in white, cream, blue, green or red vitreous enamel £2 16 7 extra plus 6s 5d tax	£61 6 2	£26 17 10
Yes	Three ice-blue enamelled (with gold trim) and 1 plate-glass shelves, large freezer and chiller dish. Thermostatic " Buttador," egg rack and 2 bottle shelves in door	$\frac{1}{8}$ h.p.	—	White or cream stoved enamel	£105 16 11	£46 8 1
No	Audible alarm against rise in temperature and automatic reset	$\frac{1}{8}$ h.p.	—	White or cream stoved enamel	£124 7 6	£54 2 6
Yes	Two ice-blue enamelled and 1 plate-glass shelves, freezer and chiller dish. Thermostatic " Buttador," egg rack and bottle shelf in door	$\frac{1}{10}$ h.p.	—	White or cream stoved enamel, table top in white, cream, blue, green or red vitreous enamel £2 16 7 extra plus 6s 5d tax, or armoured plate glass £4 14 4 extra plus 10s 8d tax	£62 15 1	£27 10 11

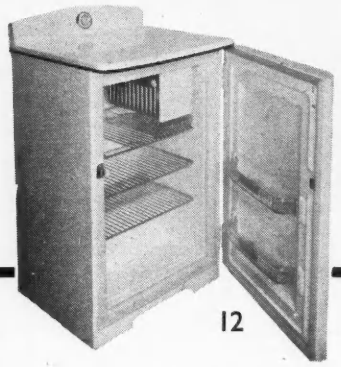
8

8. Frigidaire DY–101 de-luxe refrigerator
9. Kelvinator model K.45 GT
10. Kelvinator model CK.26G.8

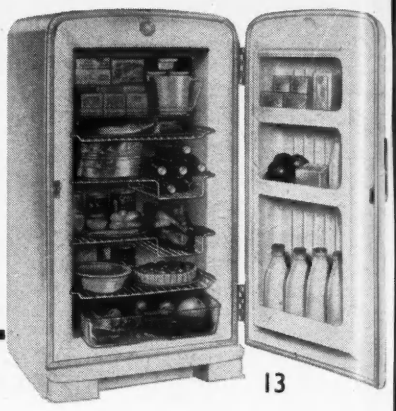
9

10

11



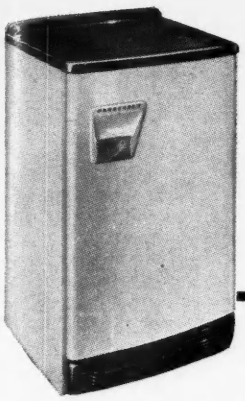
12



13

Manufacturer	Model	Type	External Dimensions (height, width & depth in inches)	Capacity	Shelf Area	Ice Capacity	Salad Crisper	Frozen Food Chest	Interio Light
KELVINATOR, LTD., Hudson Motors Building, Great West Road, London, W.4.	" Kelvinator " K45GT or GTC	Compressor	36⅜×24⅜×26	4·5 cu ft	6·75 sq ft	16 cubes	No	Yes	Yes
	" Kelvinator " C210K or KC	Compressor	42¾×24×25½	5·6 cu ft	9·5 sq ft	32 cubes	Yes	Yes	Yes
	" Kelvinator " C225K or KC	Compressor	53⅛×24×25½	7·4 cu ft	13 sq ft	32 cubes	Yes	Yes	Yes
	" Kelvinator " CK26G8 or G8C	Compressor	53½×24¼×26⅛	8 cu ft	14 sq ft	46 cubes	Yes	Yes	Yes
Lec REFRIGERATION, LTD., Shripney Works, Bognor Regis.	P.42	Compressor	44×23⅛×25½ (incl. handle)	4·2 cu ft	8 sq ft	12 cubes	No	Yes	Yes
	" International "	Compressor	44×23⅛×25½ (incl. handle)	6 cu ft	10·7 sq ft	24 cubes	Yes	Yes	Yes
	" Continental "	Compressor	57⅜×26⅛×27⅛ (incl. handle)	8 cu ft	14·5 sq ft	24 cubes and multiple cocktail ice portions	Yes	Yes	Yes
	HF4 (Home freezer)	Compressor	44×23⅛×25½ (incl. handle)	4 cu ft	8 sq ft	—	—	—	—
	CF25 (Home freezer)	Compressor	41×38⅛×23⅛ (incl. handle)	5·4 cu ft	—	—	—	—	—
LIGHTFOOT REFRIGERATION CO., LTD., Abbeydale Road, North Circular Road, Wembley, Middx.	4.LDR	Compressor	40×23×25⅝	4·2 cu ft	7·7 sq ft	1·4 lb	No	Held in freezer	Yes
	5.LDRM	Compressor	53 1/16×27½×23 1/16	5·6 cu ft	9·1 sq ft	2·8 lb	Yes	Held in freezer	Yes
	8.LDRB	Compressor	55 11/16×27 13/16×28 1/16	8·1 cu ft	15·2 sq ft	2·8 lb	Yes (two)	Yes	Yes
R. & A. MAIN, LTD., 48, Grosvenor Gardens, London, S.W.1.	Main " 36 "	Absorption	46¼×24½×24¾	3·6 cu ft	7 sq ft	2 lb	Yes	Yes (4 lb)	No
MORPHY-RICHARDS, LTD., 6, Conduit Street, London, W.1.	" Astral " BM/E	Absorption	26×20½×21¼	1·5 cu ft	3·1 sq ft	1·1 lb	No	No	No
	" Astral " BL/E	Absorption	36×20½×21¼	1·5 cu ft	3·1 sq ft	1·1 lb	No	No	No
	" Astral Console " BP/A	Absorption	36×22×21¼	2·3 cu ft	5 sq ft	1·1 lb	No	No	No
	" Astral Commodore " A.400A	Absorption	41⅛×22½×24	4 cu ft	8 sq ft	1·6 lb	No	Yes	No
PHILCO (GT. BRITAIN), LTD., Romford Road, Chigwell, Essex.	" Philco " 871	Compressor	56×27⅜×27½	8·1 cu ft	15·8 sq ft	2¾ lb	Yes	Yes	Yes
PRESTCOLD REFRIGERATION DIVISION, PRESSED STEEL CO., LTD., Cowley, Oxford.	D.361	Compressor	36×22¼×22	3·6 cu ft	7 sq ft	4½ lb	No	Yes	Yes
	D.601	Compressor	47 5/16×24 15/16×25 5/16	6 cu ft	10 sq ft	24 cubes	Yes	Yes	Yes
	T.801	Compressor	56 5/16×27½×27	8 cu ft	12½ sq ft	36 cubes	Yes	Yes	Yes

11. *Philco model 871*
12. *Lightfoot model 4.LDR*
13. *Morphy-Richards 4 cu ft "Commodore" model*
14. *Prestcold D.361 3·6 cu ft model*
15. *Lec Refrigeration 6 cu ft "International"*
16. *Main "56" refrigerator*



14

15

16

Frozen od Chest	Interior Light	Special Features	Motor	Element Loading	Finish	Price (excl. tax)	Purchase Tax
Yes	Yes	Table top, pint size milk bottle storage in door	⅛ h.p.	—	White or cream stoved enamel	£52 7 8	£22 12 4
Yes	Yes	—	⅛ h.p.	—	White or cream stoved enamel	£67 17 4	£29 12 8
Yes	Yes	—	⅛ h.p.	—	White or cream stoved enamel	£74 5 1	£31 16 11
Yes	Yes	Automatic defrost in both freezer and storage compartments	⅛ h.p.	—	White or cream stoved enamel	£94 2 8	£40 17 4
Yes	Yes	Adjustable shelf, door shelves, butter compartment	⅛ h.p.	—	White, cream or green stoved enamel	£50 19 0	£21 19 4
Yes	Yes	All plastic interior, adjustable shelves, door shelves and butter compartment	⅛ h.p.	—	White or cream stoved enamel	£56 17 6	£24 13 0
Yes	Yes	Three door shelves, butter compartment and "Coolarder"	⅛ h.p.	—	White, cream or green stoved enamel	£83 10 0	£36 5 5
—	—	Adjustable shelves	⅛ h.p.	—	White stoved enamel	£60 15 0	£22 4 3
—	—	Automatic alarm and locking handles available as optional extras	⅛ h.p.	—	White stoved enamel	£89 0 0	£34 16 2
eld in eezer	Yes	Exterior thermostat control knob, door racks, table top	⅛ h.p.	—	White stoved enamel	£54 16 2 (including service fee)	£23 18 10
eld in eezer	Yes	Door racks, Large evaporator and chiller tray	⅛ h.p.	—	White stoved enamel	£75 13 3 (including service fee)	£32 9 9
Yes	Yes	Door racks, divided chiller tray, butter compartment in door	⅛ h.p.	—	White stoved enamel	£101 2 0 (including service fee)	£43 16 0
Yes lb)	No	Cooler unit guaranteed for 10 years	—	180 W	White	£49 17 0	£22 12 0
No	No	Adjustable shelves	—	95 W	White or cream stoved enamel	£29 14 9	£13 6 3
No	No	Adjustable shelves	—	95 W	White stoved enamel	£32 11 9	£14 11 9
No	No	Adjustable shelves	—	95 W	White or cream stoved enamel	£36 19 10	£16 11 2
Yes	No	Adjustable shelves	—	120 W	White or cream stoved enamel	£45 13 11	£20 9 1
Yes	Yes	Butter keeper and bottle racks	⅛ h.p.	—	Titanium white	£96 12 0 (plus £4 10s service fee)	£43 16 0
es	Yes	48 colour combinations, "Prestalok" door lock, table top	⅛ h.p.	—	Synthetic enamel	£52 0 0	£22 13 5
es	Yes	Three colours, "Prestalok" door lock	⅛ h.p.	—	Synthetic enamel	£80 10 0	£35 2 9
es	Yes	Automatic defrosting, "Prestalok" door lock, long-term frozen food storage	⅛ h.p.	—	Synthetic enamel	£110 10 0	£48 5 9

GENERATION AND DEVELOPMENT

Sales of Domestic Appliances

An improvement in the sales of cookers, water heaters and washboilers by the Area Electricity Boards in England and Wales is shown in a return issued by the Central Electricity Authority. More refrigerators were sold in the quarter ended 31st March last than in the corresponding period a year ago, but sales of washing machines remain below the 1955-56 level. In assessing the figures, it must be remembered that the sales by Area Boards represent only a part of total sales throughout the country.

	Sales in quarter ended 31st March, 1957		Sales in twelve months ended 31st March, 1957	
	Total	% change over corresponding period of previous year	Total	% change over corresponding period of previous year
Cookers	53,601	+ 17·9	214,881	+ 3·4
Water Heaters—				
Immersion ...	23,123	+ 11·1	135,975	0·0
Storage ...	10,224	− 5·3	41,603	+ 4·4
Wash Boilers ...	20,542	+ 55·9	69,236	+ 27·8
Washing Machines	18,174	− 11·2	69,352	− 45·0
Refrigerators ...	5,041	+ 33·9	33,388	− 36·9

Higher Output in April

In April there was a small gain in electricity output, the first shown since January in the monthly statements issued by the Ministry of Power. As will be seen from the accompanying table, the total quantity of electricity generated by the Central Electricity Authority, the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board last month was 7,117 million kWh, an increase of 2·4 per cent. In the first four months of the year the total output (31,825 million kWh) was 1 per cent less than in the corresponding period of 1956.

In addition to public supply, 3,520 million kWh was generated by industry (excluding railways, transport undertakings, coal mines, gas works and petroleum refineries) in the four months up to 27th April last; this compares with 3,368 million kWh for the same period of 1956, an increase of 4·5 per cent.

Somerset Nuclear Station Inquiry

As briefly reported in last week's issue, the inquiry into the Central Electricity Authority's proposal to build a nuclear power station at Hinkley Point, Somerset, was opened at Bridgwater on 14th May. It was conducted jointly by Mr. H. W. Grimmitt, chief engineering inspector of the Ministry of Power, and Mr. H. R. Wardrill, of the Ministry of Housing and Local Government.

For the C.E.A., Mr. D. Cooke said that the station would have a capacity of 500 MW. There would be two reactor buildings about 175ft high but nothing in the nature of chimneys. A turbine house about 60ft high would be on the sea side of the site and the other building on the land side. They would be designed by architects of the highest standing. Skilled architects and landscape consultants would be employed. It was a very suitable site; it had good strong foundations, abundant cooling water from the sea, and also fresh water supplies. No one had been able to suggest a site where there would be less interference with agricultural land.

About 350 to 400 men would be the permanent establishment, and he was confident that it could be arranged for these to be absorbed into the community. About 2,500 men would be needed for construction.

On the safety factor, Mr. Cooke said the C.E.A. was co-operating with the Atomic Energy Authority. This type of plant was inherently safe, and the radioactivity of discharges would be very low and quite harmless.

"While we are always sorry to come to an unspoilt stretch of land, balancing all the considerations as best we can we think that we have a good case for asking permission to come to this site," he said.

Sir Josiah Eccles, deputy chairman (operation), C.E.A., said that because of the growing demand for electricity the Authority would have to find sites for 34 nuclear and conventional type power stations by 1962. If permission was granted, it was hoped to start work at Hinkley Point in the autumn, and the station would be operating by the end of 1961. In reply to a question by the representative of the Council for the Preservation of Rural England, he said that Hinkley Point would be "capable of sustaining a second instalment that might well be of the same order as that which we are now talking." It would be a new application requiring new planning consent.

Replying to Mr. Cyril Williams, for the Quantock Seaboard Defence Committee, Sir Josiah said that if coastal sites could be found for nuclear power stations of a million kilowatt capacity, six would be needed. If the stations were the size of the one proposed for Hinkley Point, twelve would be needed. In any case, he thought the figure of 19 already quoted was excessive.

Mr. L. C. Rowe, for Mrs. D. Irving-Bell, a landowner, said that apparently the scheme would involve erecting a line of 130ft pylons from Hinkley Point to Melksham, right across Somerset which was a county of great beauty. Mr. D. Clark (station development engineer, C.E.A.) pointed out that the link with the national grid would be necessary whether there was a nuclear power station at Hinkley Point or not. Without this power station the pylon route would be from Melksham to Taunton. They could not provide electricity for the people without overhead lines. Putting them underground would be 15 times more expensive.

The water used for cooling would ultimately be discharged into the sea. It would be quite safe for swimming and would be 15 deg F warmer. "Where we have gone so far, it has been very popular," he added.

Replying to further questions, he said they expected to operate the station without endangering anyone, although obviously they could not guarantee that there would never be an accident of any kind.

On the second day it was suggested on behalf of the recently formed

ELECTRICITY GENERATED AND SENT OUT FOR PUBLIC SUPPLY

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total		
Central Electricity Authority ...	3,335	64	31·4	6,523	6	6,535	6,131	22,604
North of Scotland H.E.B. ...	11	—	1·1	19	114	137	136	807
South of Scotland E.B.	222	5	0·1	430	15	445	420	1,368
Total for April, 1957	3,568	69	32·6	6,972	135	*7,117	6,687	24,779
Corres. total for April, 1956 ...	3,560	78	34·3	6,854	86	6,952	6,526	22,705
Inc. or dec., per cent	+0·2	−11·6	−5·0	+1·7	+56·5	+2·4	+2·5	+9·1
Total to date (4 months) 1957 ...	16,038	324	71·6	30,878	901	31,825	29,945	
Total for corres. 4 months of 1956	16,611	350	139·2	31,540	547	32,156	30,253	
Inc. or dec., per cent	−3·5	−7·5	−48·6	−2·1	+64·7	−1·0	−1·0	

* The total figure includes generation by other methods amounting to 10 million kWh.

Quantock Seaboard Defence Committee that alternative sites near Watchet, Clevedon and Portishead should be considered. Mr. M. B. Osmund (C.P.R.E.) contended that the Government's policy of building nuclear stations in sparsely populated districts should be reviewed, saying there was no evidence that the public were apprehensive about such stations being placed in built-up areas.

Mr. E. S. Rickards, clerk to the Somerset County Council, said that the Council, as planning authority, did not object to the scheme but regretted the application on the grounds of amenity, especially as it was absolutely contrary to the county development plan. The Council asked for assurances regarding water intake, outflow pipes, etc., and that archæologists should be given access to the site during the C.E.A. excavations.

After the close of the inquiry the commissioners inspected the site.

Measuring Power Line Heights

When erecting new telephone lines which have to cross existing power lines Post Office engineers have to assess the heights above ground of existing power lines in order to arrange for proper clearances, and in this connection a fatal accident occurred recently when a measuring tape touched a power conductor.

This has led to the trial by Post Office engineers of new optical height measuring devices by which an engineer can, whilst standing beneath a power line, ascertain the precise height of the line above the ground. We learn that experiments with prototype instruments have been so successful that it is hoped to adopt one of them for general use.

Sudbury Reinforcement Scheme

As part of a scheme of reinforcement costing just over £100,000 which will enable the Eastern Electricity Board to meet the increasing demand for electricity, particularly from industry, in the Sudbury (Suffolk) district, a 7,500 kVA substation was recently opened by the Mayor (Councillor E. A. Essex).

Situated in Waldingfield Road, the substation is supplied from two 33 kV lines, one from Bury St. Edmunds via Belchamp and the other from Stowmarket via Hadleigh. A new 11 kV underground ring main with spurs which will be fed from this substation is about to be laid in the borough and ten additional distribution substations will also be constructed.

Dust Nuisance

The Central Electricity Authority, which has received complaints from Newcastle City Council about the amount of dust settling on the west end of the city from the Dunston and Stella power stations, has announced that it is proposed to spend £250,000 installing equipment which, it is expected, will reduce the nuisance by half.

Electric Heating for Flats

Sunderland Town Council is to spend over £2,000 on installing electric room heating and water heating systems in 28 flats in the Ashwell Road area where there is smoke nuisance from the existing solid fuel fires.

Hebburn (Co. Durham) U.D.C. is being recommended to build all-electric flats in Station Road. They will have under-the-floor electric heating. Running costs are expected to be about £33 per annum for one-bedroomed flats.

Appliance Maintenance Scheme

It was reported to the Fife Area Committee of the South of Scotland Electricity Consultative Council, which met at Kirkcaldy recently, that the Board had decided to introduce a standard maintenance scheme for cookers and wash-boilers, the charges being 2s 6d and 6d, respectively, or 2s 6d only if both were installed in the same house. The Committee welcomed the scheme and expressed the view that the terms were extremely favourable.

After the meeting the Committee visited the Burgh Council's all-electric flats where members were assured of the adequacy of the floor heating system and the greater cleanliness which resulted. From an analysis of the first year's working, the average cost for two-roomed flats was said to be 10s 9½d a week and for three-roomed flats 14s 3½d, covering both heating and hot water.

OVERSEAS

Nationalisation in Ceylon?

Nationalisation of electricity generation and distribution in Ceylon is recommended by Mr. J. G. Park, Electrical Adviser to the Government, in a report to the Minister of Transport and Works, Mr. Senanayake. Mr. Park proposes the immediate establishment of a statutory electrical authority to be known as the Central Electrical Board which would have sole control of electricity, except temporarily the Gal Oya area. The Board would be accountable to Parliament through the Minister in respect of major policies and conduct of the industry. Other recommendations are the establishment of Electrical Consultative Councils to represent consumers, and of an Electrical Inspectorate Branch directly under the Ministry of Transport and Works.

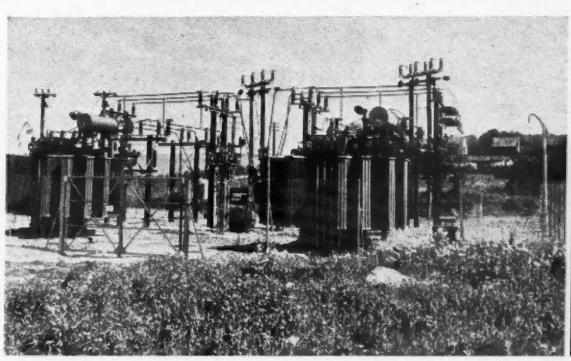
One of the most pressing necessities, says Mr. Park, is the restoration of confidence in the industry as this has been gravely reduced by the shortage of power in recent times. He adds that confidence will only be restored and retained by the provision of plant of adequate capacity to meet the full requirements of expansion.

Mr. Park's terms of reference were to review the organisation of the public generation, transmission and distribution of electricity in the island, and to make recommendations as to the organisation required for the future development of electricity.

Limerick Transformer Station

The Irish Electricity Supply Board is to build a transformer station at Dooradoyle on the outskirts of Limerick at a cost of over £100,000. It will take two years to complete and will be the biggest transformer station ever to be built by the Board. It will supply power over an area of 5,000 square miles.

The new Sudbury substation and (right) the Mayor (Cr. E. A. Essex) operating the switch. With him (left to right) are Mr. F. F. Ayrton-White (Sudbury service manager), Mr. G. N. H. Mayes (Stowmarket district manager), Mr. P. Sydney (sub-area manager), Mr. G. H. Tilbrook (sub-area engineer), Mr. S. J. Blackwell (Sudbury borough engineer) and Mr. R. Coates (town clerk)



NEW ELECTRICAL EQUIPMENT

"Tersil" Cable for Aircraft

For use on the Proteus 755 turbo-prop engine and power plants in the Britannia 300, Bristol Aero-Engines, Ltd., have approved a new type of cable known as the "Tersil." This cable is now being manufactured by W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., 51-53, Hatton Garden, London, W.C.2.

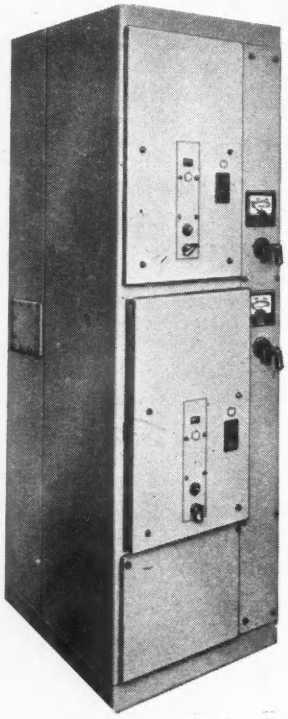
"Tersil" cables have nickel-plated copper conductors and an insulation consisting of silicone rubber, glass and polythene terephthalate, which is the chemical name for the better-known "Terylene" and "Melinen" materials. This construction enables the cable to function continuously in ambient temperatures ranging from −50 deg C or lower to +150 deg C. In addition the cable has the very important property of being able to function during and after a fire.

The ratio of insulation resistance of "Tersil" to that of "Pren" is of the order of 250 or more to one, and the straight 50 c/s breakdown voltage of a "Tersil" cable having a 40/·0076in conductor is approximately 12,000 V. A wide range of single-core "Tersil" cables known as "Uni-tersil" is now being manufactured. The conductor sizes and overall dimensions will be identical with those of "Uni-pren" cables. Screened cables, having a tinned copper metal braid applied overall are also being manufactured under the name of "Uni-tersilmet." The Ministry of Supply Air Division is preparing a specification covering the range of aircraft cables.

A further point of interest to the aircraft constructor is that the new cables are lighter than the corresponding size "Pren" cables.

"Uni-tersil" 100 cable conductor

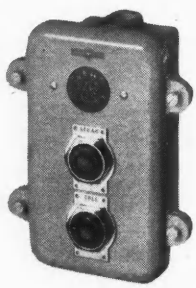
Bertram Thomas Type LVD double-tier unit



Hair Dryer

The new "Fair-Lady" hair dryer now being produced by L. G. HAWKINS & CO., LTD., 30/35, Drury Lane, Kingsway, London, W.C.2, is not only supplied complete with a presentation case (which forms its stand), but also with a plastic hood. In practice the lid is removed from the case, the flex unwound and plugged in, the hood slipped on to the nozzle of the dryer, and it is ready for use. Its powerful motor (11,000 r.p.m.), suppressed for TV and radio, ensures maximum efficiency. Four colours are available, ivory, blue, pink and green, and its weight is 1½ lb. The price, complete with presentation case and hood, is £3 17s 6d, plus 17s purchase tax in the United Kingdom.

L. G. Hawkins "Fair-Lady" hair dryer complete with presentation case and hood



Bulkhead microphone control unit, SH80 (Communication Systems)

Works Communication System

A new bulkhead microphone control unit specially designed to meet the requirements of industrial establishments in which noise makes the use of normal communication methods unsuitable, is being marketed by COMMUNICATION SYSTEMS, LTD., Strowger House, 8, Arundel Street, London, W.C.2.

A typical system consists of a central amplifier and a number of bulkhead microphone units, with associated loudspeakers, placed at key points throughout the plant. An operator wishing to make an announcement presses a red "call" button, which produces a warning note in all the loudspeakers in the network. He then presses the green "speak" button, and holds it depressed, while broadcasting the message.

During transmission the local loudspeaker is muted, or partially attenuated, to avoid feedback. When the button is released the microphone station is ready to receive replies from other points similarly equipped.

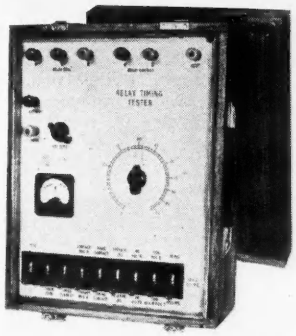
The unit is known as the SH80 and has a weatherproof robust cast-metal housing. Portable models of this equipment, which can be plugged in at strategic points, are also available.

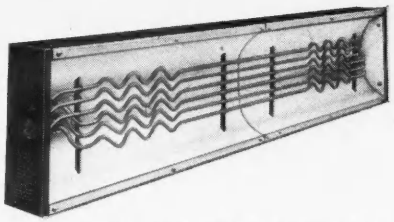
Medium Voltage Distribution Switchgear

Switchgear for medium voltage distribution is being introduced by BERTRAM THOMAS (ENGINEERS), LTD., Worsley Street, Hulme, Manchester, 15. The gear has been designed expressly for the protection of power station auxiliaries, rolling mills, steel works and other heavy industrial plant where maximum reliability is of importance. Standard cubicle type units and complete multi-unit switchboards can be supplied.

Single-tier, Type LVS, and two variations of double-tier arrangements, Types LVD and LVL, are available, each incorporating horizontal drawout air-break circuit-breakers and air-insulated busbar systems, up to 3,000 A. The air-break circuit-breakers have been A.S.T.A. approved, and short-circuit tested in accordance with B.S. 116/1952, and are available for current ratings up to 2,400 A, with rupturing capacities up to 31 MVA at 415 V.

Complete systems of mechanical interlocks are embodied to prevent





Above: "Metrovick" infra-red projector with crimped elements

Left: Quality Electronics G.E. tester for checking relay timing characteristics

incorrect operation and inadvertent access to "live" parts. The illustration shows a Type LVD double-tier unit, incorporating two 1,600 A draw-out type air-break circuit-breakers. The lower circuit-breaker is in the isolated position.

Relay Testing Instruments

Two new instruments for testing relays have recently been announced by QUALITY ELECTRONICS, LTD., 47-49, High Street, Kingston-on-Thames. They are the A.E. tester for checking relay current adjustments and the G.E. tester for checking relay timing characteristics. Each instrument is fitted into a teak case 15in by 12in by 6½in and has a "Formica" panel. Components are tropicalised where possible.

The A.E. tester is designed for applying a series of current tests; separately controlling or presetting each test supply by a potentiometer; indicating the value of test current on a 5-range milliammeter (up to 500 mA max.); testing relays, having coils connected to battery, to earth or as a loop. This tester requires an external supply of d.c. nominally 50 V at not more than 0·5 A.

The G.E. instrument is designed for measuring the lag of a relay by means of a meter and timing scale; measuring the operate or release lag; using a make or break action on the relay; testing the relay with either battery, earth or loop conditions connected to the coil and contact. An external source of d.c. power of either 24, 40, 50 or 60 V is required.

High Intensity Infra-red Projector

In an industrial process such as the application of latex or p.v.c. to carpet or leathercloth, infra-red heating has proved itself to be very suitable for curing the substance applied. A high intensity infra-red projector is now being manufactured by the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, 17, to carry out this process. It consists of a standard "Metrovick" infra-red projector with an anodised aluminium reflector in a robust lightweight metal casing and tubular sheathed elements operating at red heat. The elements have crimped ends to provide a greater intensity of heat on the outer edges of the material being heated.

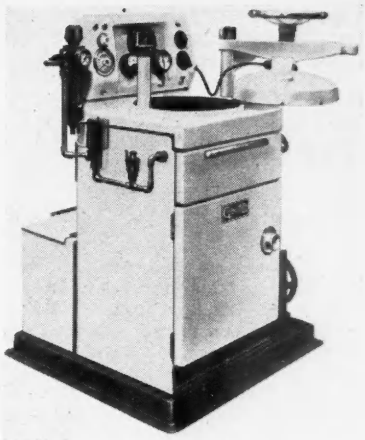
The new projectors can be supplied in the same lengths as the standard "Metrovick" infra-red projectors, i.e. 18in up to 7ft. The element itself is constructed by inserting a magnesium tube into an outer sheath of non-scaling, non-corrodible alloy and introducing within the magnesium tube a helical coil of the highest grade heat resisting wire. The magnesium is then converted by a special process into solidly packed magnesium oxide. This ensures perfect centralisation of the spiral and an even thickness of insulation between spiral and sheath. The element will withstand rough handling and is strong enough to support its own weight with a minimum of tie-bars and supports. The sheath is insulated from the live spiral and may be earthed.

Prices of these projectors vary according to length and loading: a 6ft type with a loading of 14·2 kW costs £38 10s and delivery time is approximately six weeks.

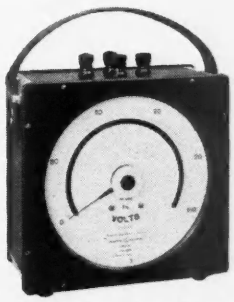
Portable Instruments

A range of moving coil ammeters and voltmeters which are believed to be the first portable type instruments available having circular scales and spring-mounted, sapphire jewel bearing and shock resisting movements have recently been introduced by CROMPTON PARKINSON, LTD., Crompton House, Aldwych, London. The new instruments have scales subtending 240 deg which are 11in in length. The magnet system is a self-shielding type with two anisotropic magnets and the complete arrangement is such as to yield a high torque without necessitating recourse to small gap clearances or to a large number of milliampere turns on the winding.

The standard instruments have "industrial" accuracy, but "precision" accuracy can be provided if required. Current ratings available with the standard instruments cover any range from 0-200 microamperes to 0-150 amperes and voltage ratings cover any range from 0-0·075 V to 0-750 V. Some of the instruments can be fitted with full-wave rectifiers and calibrated for use on a.c. circuits. A further adaptation of the standard



Type P14 packaged impregnation plant



Crompton Parkinson portable circular scale instrument

instruments is that they can be supplied as "universal indicators." Suitably arranged with a scale divided into 150 parts and used with easily fitted multipliers, they enable a wide range of current and voltage measurements to be made with a minimum of apparatus.

Impregnation Plant

A small semi-automatic impregnation plant is now being manufactured by the GENERAL ENGINEERING CO. (RADCLIFFE), LTD., Station Works, Bury Road, Radcliffe, Lancs. Operation of the plant is simplified by the use of electromagnetically operated valves for all services, controlled from a single multi-position switch, giving effective interlocking and preventing mal-operation by unskilled personnel. The Type P14 packaged impregnation plant is available in three forms suitable for various types of impregnations and processes, as follows:—Assembly A: For all "ambient" type impregnants where it is unnecessary to heat or evacuate the impregnant storage tank. Assembly B: Similar to A but with provision for heating the impregnant storage tank. Assembly C: Similar to B but with special impregnant storage tank capable of being evacuated. This type is suitable for oil and wax impregnants. Special provision is made for dehydration and de-aeration before use.

Financial Section

STOCKS and SHARES

CONTINUING their downward drift, Government stocks had returned by the beginning of this week to their lowest prices of the year. In the market for industrial ordinary shares, on the other hand, conditions remained active and generally buoyant. This evidence of the trek of capital from gilt-edged to industrials stands out as the chief feature in the investment scene at present. It has become especially pronounced since another series of wage increases came into prospect two months ago. Evidently the conviction grows that the larger element of risk in ordinary shares is a fair exchange, in to-day's circumstances, for a better chance of maintaining the capital value of investments and the purchasing power of the income from them. This idea persists without any great encouragement from the company news, which brings recurrent reminders of the erosion of profit margins through the action of rising production costs.

Good Features

Among the improvements noted this week in the electrical share list, one of the largest took place in Ward & Goldstone £1 shares, which jumped from 48s to 56s 3d, before reacting to 55s. The company's financial year ended in March, and the activity in the shares was taken as a token of optimism about the coming results. These were published last year in mid-June, when a large expansion of earnings and an increased, but still highly conservative rate of dividend were declared. Another good feature was the improvement in Brook Motors 10s shares, to 36s 3d, on confirmation in the company's first interim report that revenues in the first six months of the current financial year amounted to £410,000, whereas half the revenue for the full year 1955–6 had been £240,000. Order books are stated to remain satisfactory.

Other Improvements

There was little further change in the shares of the principal electrical groups, but among the heavy engineering companies associated with them, the irrepressible Clarke Chapman shares rose yet another 7s 6d to 177s 6d (the official quotation remained at 170s). Head Wrightson (under the influence of the recently published accounts) also performed well, and John Thompson were firm in anticipation of the annual results. Shares connected with radio and domestic appliance manufacturing were in favour. Ever Ready were particularly strong in advance of the dividend declaration. Pye, E.M.I., Thorn and E. K. Cole also improved. Hoover, Morphy-Richards and Falk Stadelmann were well supported, and Vactric went further ahead to 23s, after a temporary check imposed by the denial of a "bid" rumour. Aerialite have been firm at 6s since the announcement of a higher interim dividend. English Electric new ordinary shares maintained a premium of 10s 9d. Shareholders of the company are reminded that next Tuesday (the 28th) is the

Price Changes in

Company or Board	Nom. Value	Middle price 20th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	74½	−1	3	3	3 19 6	80	75
Brit. Elec. 1974/77	100	72½	−2	3	3	4 1 9	78½	73½
Brit. Elec. 1976/79	100	76½	−2	3½	3½	4 11 6	81½	76½
Brit. Elec. 1974/79	100	87½	−3	4½	4½	4 17 3	92½	87½
Overseas Electric Supply								
Calcutta Elec.	£1	18/-	−1/-	6†	6†	6 13 3†	19/-	18/-
East African Power	£1	20/6	−6d	7	7	6 16 6	21/-	19/3
Nigerian Elec.	£1	17/6		10	10*	11 8 6	18/6	17/3
Perak Hydro-Elec.	£1	17/6	+6d	10	10*	11 8 6	17/6	13/3
Electrical Shares								
Aberdare Cables	5/-	12/6		17½	17½	7 0 0	12/6	9/9
Aerialite	1/-	6/-x.d.		45	48	8 0 0	6/-	4/9
Allen, W. H.	£1	44/6		20	10*	4 10 0	44/6	33/6
Anglo-Portuguese Tel.	£1	25/9	−1/-	8	8	6 4 3	27/6	20/6
Aron Elec. Ord.	£1	56/3		15	15	5 6 9	56/3	53/6
Assd. Automation	10/-	24/9		10	5	2 0 6	24/9	17/9
Assoc. Elec. Ord.	£1	67/6	−1/3	15	15	4 9 0	73/-	62/6
Automatic Tel. & El.	£1	72/6		15	17	4 13 9	72/6	54/6
Babcock & Wilcox	£1	75/-		15	15	4 0 0	82/6	71/6
Bakelite	10/-	24/6		16	15	6 2 6	24/6	20/9
Baldwin, H. J.	2/-	4/-	−3d	20	20	10 0 0	5/-	4/-
Berry's Electric	5/-	6/3		—	10‡	8 0 0	6/3	5/6
British Aluminium	£1	70/-		12	12	3 8 6	71/3	63/9
Brit. Elec. Traction: Def. Ord. "A"	5/-	22/3		22½	22½	5 1 3	22/3	17/-
B.I. Callender's	£1	51/9x.d.		12½	12½	4 16 6	55/-	48/3
B.I. Callender's 6% Pref.	£1	21/-		6	6	5 14 3	21/9	20/6
British Tabulating	£1	56/3		9	9	3 4 0	56/3	42/-
British Thermostat	5/-	27/-		25	25	4 12 6	27/6	25/9
British Vac. Cleaner	5/-	6/3x.d.	+3d	15	10	8 0 0	8/-	6/6
Brook Motors	10/-	36/3x.d.	+2/9	25	15	6 18 0	36/3	30/-
Brush Group	5/-	8/-		10	Nil	—	8/-	4/6
Bulgin, A. F.	1/-	5/-		50	40*	8 0 0	5/6	4/6
Burco Dean	5/-	12/6x.d.		22½	20	8 0 0	13/-	8/9
Cable & Wireless: Ord.	5/-	11/9	+3d	10	10	4 5 0	12/-	9/6
4% Loan	100	92½		4	4	4 6 6	92½	89
Chloride El. Storage "A"	£1	68/9	+1/3	17½	17½	5 1 9	68/9	58/-
Clarke Chapman	£1	170/-		22½	27½	3 4 9	8⅞	6¼
Cole, E. K.	5/-	23/3	+9d	17½	17½	3 15 3	23/3	16/6
Cossor, A. C.	5/-	6/-		15	Nil	Nil	7/3	5/9
Crabtree	10/-	25/6		20	20	7 16 9	25/6	23/3
Crompton Parkinson Ord.	5/-	16/6		16	16	4 17 0	17/9	14/5
De La Rue	5/-	20/6	+1/6	30	30	7 6 3	20/6	16/3
Decca "A"	4/-	28/-	−9d	43¾	43¾	6 5 0	32/3	27/-
Desoutter	5/-	33/6		30	32½	4 17 0	33/6	27/6
Dewhurst	2/-	7/-		30	16¼*	4 12 9	7/6	5/9
Dictograph Tel.	2/-	7/9		20	20	5 3 3	7/9	6/9
Dubilier Condenser	1/-	5/9	+3d	25	30	5 4 3	5/9	5/6
Duport	5/-	19/-		23	25	6 11 6	19/6	17/6
E.M.I.	10/-	32/6	+1/3	15	15	4 12 3	33/3	23/9
Electrical Components	5/-	7/6		25	25	8 6 9*	7/6	6/6
Elec. Construction	£1	27/6	+1/3	8½	8½	6 3 9	27/6	21/9
Elliott Bros.	5/-	29/9x.d.	+9d	17½	20	3 7 3	29/9	26/3
Enfield Cable Ord.	£1	15/-	−1/3	Nil	Nil	Nil	21/6	13/-
English Electric	£1	58/9		12½	14	4 15 3	60/-	47/6
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/3	13/-
Ericsson Tel.	5/-	46/-		20†	22†	2 7 9†	46/-	33/3
Ever Ready	5/-	36/9	+1/9	35	35	4 15 3	36/9	30/-
Falk Stadelmann	£1	40/6	+1/3	17½	17½	8 12 9	40/6	35/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

last day for the receipt of acceptances, as well as for applications for "excess" shares.

Richardsons Westgarth Results

Richardsons Westgarth 5s shares have enjoyed popularity this year, partly no doubt through the company's association with the Atomic Power Constructions company. At the present price of 20s they have a still uncommon distinction in standing above the highest points recorded during the industrial market's last big boom in 1955. They remained very firm after publication of the results for the year ended in March. From the preliminary statement, it appears that the receipt of nine months earnings from the newly acquired Humber Graving Dock Company accounts for the most of the increase in the group profit from £495,000 to £656,000. The dividend is being repeated at 16⅔ per cent on capital enlarged by the shares issued in connection with that acquisition, since when the company has also absorbed Parsons Marine Turbine by an exchange of shares.

Electrical Investments

Company or Board	Nom. Value	Middle price 20th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield% £ s d	1957 Highest	1957 Lowest
Electrical Shares—continued								
G.E.C. Ord.	£1	58/9		12½	14	4 15 3	58/9	48/9
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/6	22/-
General Cables	5/-	12/9		30	30	11 15 3	13/6	11/6
Greenwood & Batley	£1	47/6	+1/3	17½	17½	7 7 3	47/6	45/3
Hackbridge Holdings	5/-	21/3	−6d	25	30	7 1 3	21/9	19/9
Hackbridge & Hewittic	5/-	15/-		30	23*	7 13 3	16/-	13/6
Head Wrightson	£1	137/6	+5/-	20	22½	3 5 6	137/6	112/6
Heatrae	2/-	4/6	+3d	15	15	6 13 3	4/6	4/-
Henley's	10/-	15/9		11½	11½	7 6 0	17/-	15/3
Holophane	5/-	26/3x.d.	+2/-	30	30	5 14 3	26/3	17/-
Hoover	5/-	39/6	+1/-	50	50	6 6 6	39/6	24/9
I.C.I.	£1	45/9	+1/-	10	10	4 7 6	46/6	37/9
Intl. Combustion	5/-	28/9	−1/3	20	22½	3 18 3	30/-	20/-
Johnson & Phillips	£1	30/-x.d.		15	10	6 13 3	34/6	28/3
Lancashire Dynamo	£1	43/9		11	11	5 0 6	45/-	36/9
Laurence, Scott	5/-	19/3	−6d	15	15	—	19/9	13/9
Lister, R. A.	£1	31/9	+6d	9·3	10	6 6 0	31/9	26/9
London Elec. Wire	£1	50/6	−2/-	12½	12½	4 19 0	53/9	43/-
Lucas, J.	£1	36/6	+9d	7½	7½	4 2 3	36/6	30/6
Marconi Marine	£1	33/9		10	10	5 18 6	33/9	31/-
Marryat & Scott	2/-	10/9		30	30	5 11 6	10/9	8/-
Mather & Platt	£1	61/3		15	15	4 18 0	61/3	51/3
Metal Industries	£1	25/6		9	Nil	—	26/3	20/3
Midland Elec. Mfg.	£1	48/9		12½	12½	5 2 6	48/9	45/-
Morphy-Richards	4/-	17/3	+6d	50	50	4 12 9*	17/3	11/9
Murex	£1	77/6	+1/3	20	20	5 3 3	77/6	65/-
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	2/6	2/3
Parnall (Yate)	5/-	8/3x.d.		12	12	7 5 6	8/9	5/9
Parsons, C. A.	£1	67/6	−1/3	10	10	—	71/3	50/6
Plessey	10/-	84/-	+1/6	27½	30	3 11 6	84/9	61/-
Pye "A" Deferred	5/-	20/-	+1/9	12½	12½	3 2 6	20/-	15/9
Reyrolle	£1	101/3	−2/6	16½	17½	3 9 3	110/-	90/-
Rheostatic	4/-	10/-		18¾	12½*	5 0 0	10/-	8/9
Richardsons Westgarth	5/-	20/-		16⅔	16⅔	4 3 3	20/-	17/-
Scottish Cables	4/-	18/3		27½	27½	6 0 6	19/3	15/-
Simon-Carves	5/-	31/3	+6d	28⅓	20*	3 4 0	31/3	26/-
Smith (England), S.	4/-	15/9	+6d	17½	17½	4 9 0	15/9	13/-
Southern Areas	£1	18/9		7½	7½	8 0 0	20/-	13/9
Strand Elec.	5/-	7/3	−6d	15	15	10 7 0	8/-	7/3
Sturtevant	5/-	25/9		15†	15†	2 18 3†	27/-	24/3
Sun Elec.	£1	43/9		20	25	11 8 6	43/9	43/9
Switchgear & Cowans	5/-	15/-		25	25	8 6 9	15/6	13/6
Taylor Tunnicliff	5/-	13/3		15	15	5 13 3	13/9	11/9
T.C.C.	10/-	40/-		25	25	6 5 0	40/-	35/-
T.C. & M.	£1	28/6	−6d	8½	8½	5 19 3	31/-	24/6
Telephone Mfg.	5/-	8/-		10	10*	6 5 0	8/-	6/3
Telephone Rentals	5/-	12/3	−3d	12½	12½	5 2 0	12/6	10/3
Thompson (John)	5/-	34/3	+6d	25	25*	3 13 0	37/-	29/3
Thorn Elec.	5/-	25/9	+9d	15	15	2 18 3	26/3	16/3
Thornycroft	£1	35/6	−1/-	15	12½	7 0 9	37/6	32/9
Tube Investments	£1	68/-	−9d	22½	15*‡	4 8 3	68/9	58/3
Vactric	5/-	23/-	+2/6	15	17½*	3 16 0	23/-	12/9
Veritys	5/-	9/-		12½	12½	6 19 0	9/3	8/3
Walsall Conduits	4/-	15/-	+6d	70	20*	5 6 9	15/-	11/-
Ward & Goldstone	5/-	55/-	+7/-	30	35	3 3 9	56/3	36/9
Watford	2/-	6/6	−3d	25	25	7 13 9	6/9	6/3
Westinghouse	£1	40/-		18	9‡	4 10 0	41/3	36/-
West, Allen	5/-	16/9	+3d	15	15	4 9 6	16/9	12/3
Wolf Electric	5/-	13/6	+2/6	20	20	3 14 0*	13/6	8/9

"Ekco" Loan Stock

A new issue of E.K. Cole 5¾ per cent loan stock is available in the market at about 100, and will remain transferable free of the usual 2 per cent stamp duty for the next few weeks. This £1 million issue is being made partly towards the redemption of an older loan stock, the balance of the proceeds being required for the general purposes of the business. According to the advertised particulars, the principal amount of the new stock is covered more than three and a half times by net assets of the group, while the annual amount of interest is exceeded practically fourteen times over by profits at last year's level. Redemption is to take place at par in 1982, or at a premium of a point from 1977 onwards. Interest dates are end-March and September.

Chloride Electrical Earnings

Total sales of Chloride Electrical Storage were materially increased in 1956, a year described by the chairman in the annual report as not an easy one for the company. Net profits came out about £70,000 lower than before, at just above a million, but a large part of the reduction was due to the increase in the tax charge to £1·3 million. A dividend of 17½ per cent, for the third year running, on the "A" and "B" ordinary shares is covered practically two and a half times by the surplus available for distribution and reserves. In connection with the widening spread of the group's interests beyond the motor-car industry, attention was drawn particularly by references in the report to the prospect of more demands for batteries arising from the construction of atomic power stations. With the price firmly maintained at 68s 9d, the shares are on a yield basis of a fraction over 5 per cent.

Anglo-Portuguese Telephone

The £1 shares of Anglo-Portuguese Telephone have eased to about 25s 9d, after rising from 23s 9d to 27s 6d soon after the Budget, the company having been picked out as a likely beneficiary under the proposals for tax relief to overseas trading enterprises. On the regular 8 per cent dividend, the shares offer a yield of 6¼ per cent.

REPORTS and DIVIDENDS

Harland Engineering Co., Ltd.—In the course of his review of 1956, Mr. H. Cowan-Douglas (chairman) says that the disappointing output at the Alloa works during the greater part of the year was due to a variety of causes. In the first place they were handling a rather smaller amount of hydro-electric plant. Some delays were experienced owing to shortages of materials and difficulties in the fitting and testing of some large items of plant. Probably the main cause, however, arose from the reorganisation of production systems, on which good progress is now being made. Orders booked during the year were higher than they have experienced for several years, over 40 per cent being for export to a wide range of territories. They have been successful in orders for boiler-feed pumps for thermal stations at home and on the Continent. Orders have also come in well for waterworks pumping plant, "Rotovalves" and other items in their range. Their share of the plant requirements of the nuclear power stations is steadily increasing. After referring to overseas activities, the chairman mentions the company's participation in Scottish Electrical Training Scheme, Ltd., which has been established to provide better practical and technical training facilities for university graduates, and to assist in their recruitment to Scottish industry. They have started the current year with a full order book and with much new work offering.

The Chloride Electrical Storage Co., Ltd.—The main figures in the accounts for 1956 were given in our issue of 29th April. In his review of the year, Mr. A. W. Browne (chairman and managing director) says that it has not been an easy year and costs of materials and labour continued to rise. Whilst the total sales of the group showed a material increase on last year, the sales and trading profit of the home companies which manufacture and market lead-acid batteries have been less satisfactory than formerly. A substantial increase in profits this year comes from the overseas battery companies, and this applies notably to India and South Africa. A factory is being established in Salisbury, Southern Rhodesia, to supply the market composed of the Central African Federation. A new factory is also nearing completion in Pakistan. Elsewhere various extensions to their overseas battery plants have been made to enable production to keep pace with the growing demand. The progressive dispersal of battery manufacture for the export markets from the home battery companies to the overseas companies will continue and must make more difficult of achievement economies which flow from large scale production in one place. This process of decentralisation is essential as many overseas governments are actively engaged in promoting their own industrial expansion. The United Kingdom remains not only the principal and most important country of manufacture, but is also the home of research and development. They have decided to build new premises for research and development adjacent to the factory at Clifton Junction.

G. & J. Weir, Ltd.—In his review for 1956 the Hon. J. Kenneth Weir (chairman) says that the output of the parent company fell somewhat short of the record figures of the preceding two years. This was mainly due to the completion in 1955 of the large individual contracts for distillation plants for Kuwait and Aden. On the other hand, sales were exceptionally high and by the end of 1956 the order book had expanded to a figure well in excess of the previous record set up in 1952. Orders received included one from the Island Council of Curacao for plant for combined production of fresh water and electricity, valued at £1,400,000. The plant will supply electricity at the rate of 7·5 MW. In the nuclear power field they had made substantial progress in the design of pumping equipment for reactor circuits using liquid coolants and moderators. They had received an order for main coolant pumps for the land-based reactor prototype of Britain's first nuclear vessel, H.M.S. *Dreadnought*. Apart from these special duties, their normal products have been in demand on the conventional steam raising side of nuclear installations, and they would be supplying condensing plant and boiler feed pumps for the power plant associated with the first reactor installed at Dounreay. Mr. Weir briefly refers to the activities of the other companies in the group.

Brook Motors, Ltd., has issued an interim consolidated financial statement for the six months ended 31st March last. This shows a trading profit and other revenue of the parent company of £410,216, less loss on trading of the American subsidiary company of £10,879. Depreciation absorbs £46,398 and taxation £175,576, leaving net consolidated profits of £177,363. For one half of the year ended 30th September, 1956, the trading profit was £240,228, and the net profit £67,941.

Mavor & Coulson, Ltd.—The annual meeting was held on 16th May. In their report for 1956, the directors state that the turnover and profit increased and both at home and overseas the demand for the company's products was steadily maintained. To provide for further development it is proposed to raise additional capital by offering ordinary shareholders new shares in the proportion of one for every four held, and to capitalise from reserves sufficient funds to issue as fully paid up one new share for each share held after the cash subscription. Consent to the proposals has been received from the Capital Issues Committee. Bookings this year so far are at a higher level than a year ago.

The Anglo-Portuguese Telephone Co., Ltd.—The annual meeting will be held on 6th June. In his circulated statement, Sir Alexander Roger (chairman and managing director) says that shipments of telephone plant from this country to Portugal for capital development and maintenance in 1956 cost £727,000, the total shipments for the past ten years being £5·2 million. Referring to the progress of the company, he says that a large part of the capital expenditure carried out during 1956 consisted of providing service to new subscribers by connecting up lines which had been made available in the exchanges in the previous year. The net expenditure on telephone plant again exceeded £1,000,000 and, although this was substantially less than in the previous year, the number of new stations brought into service during 1956 at 18,960, was actually slightly above the corresponding figure for 1955. At the end of 1956 the number of stations stood at 189,715 and the 200,000th station will be installed during 1957.

Richardsons, Westgarth & Co., Ltd.—The group profits for the year ended 31st March last (subject to audit) amount to £656,000, as compared with £495,000 for 1955-56. Taxation absorbed £702,000. The group profits include £154,000 for nine months of the Humber Graving Dock & Engineering Co., acquired as from 1st July, 1956. It is proposed to pay a final dividend of 10 per cent, making 16⅔ per cent for the year, on capital as increased by the issue against the Humber Graving Dock acquisition. The previous year's distribution was also 16⅔ per cent, but the interim dividend for that year was paid before a rights issue.

Richard Johnson & Nephew, Ltd., report a group net profit for the year to 30th March last of £805,840, as compared with £715,942 for 1955-56. Taxation absorbed £783,008, and general reserve receives £618,865. A special profit sharing bonus of £30,000 is allocated for workpeople. It is proposed to pay a final ordinary dividend of 5½ per cent making, with the interim dividend, the equivalent of 7 per cent for the year on the reconstructed ordinary share capital of £3,600,000.

The Atlas Electric & General Trust, Ltd., reports a gross investment income for the year to 31st March last of £1,059,886 as compared with £986,356 for 1955-56, to which is added other income making a total of £1,150,441. Taxation absorbs £473,873, and the net revenue is £547,268 (£504,553). General reserve receives £150,000 and

the final ordinary dividend is 7½ per cent (against 6 per cent), making 10½ per cent (9 per cent) for the year. The balance carried forward is £264,234 (against £234,039 brought in).

Enfield Rolling Mills, Ltd.—The annual meeting was held on 15th May. In the course of his circulated statement, the Earl of Verulam (chairman) said that they regarded the results for 1956 as satisfactory, having regard to the difficulties of trading during the year. All the subsidiaries made satisfactory progress and since the end of 1956 two more had been added to the group.

Heatrae, Ltd.—The net profit for the year ended 28th February last, after deducting £14,100 for taxation, is £14,161, as compared with £11,906 for 1955-56. The dividend for the year is maintained at 15 per cent and £42,214 is carried forward (against £33,228 brought in).

The British Thermostat Co., Ltd.—After meeting all charges, including £327,770 for taxation, the group net profit for the year to 31st January last is £295,354, as compared with £321,290 for the preceding year. General reserve, including the statutory reserve in a foreign subsidiary, requires £150,170, and the final dividend is 17½ per cent, maintaining the distribution for the year at 25 per cent. The balance carried forward is £538,750 (against £464,772 brought in).

Associated Electrical Industries, Ltd., has announced a first interim dividend for 1957 of 2½ per cent on £33,639,483 ordinary capital. A similar first dividend was paid last year on capital of £25 million.

Telephone Rentals, Ltd., reports that after providing £348,045 for taxation, the group net profit for 1956 is £421,892, as compared with £429,313 for 1955. The final ordinary dividend is 7½ per cent on capital increased by a one-for-five "rights" issue; an interim dividend of 5 per cent was paid on the smaller capital. Similar payments were made for 1955 on the old capital.

Increase of Capital

Westinghouse Brake & Signal Co., Ltd.—Increased by £4,500,000, in £1 ordinary shares, beyond the registered capital of £3,500,000.

Liquidations

Cliftons (Ashford), Ltd., radio and electrical dealers.—Winding up voluntarily. Liquidator, Mr. B. A. Reynolds, 7, Elwick Road, Ashford, Kent, appointed 29th April.

Ryhope Radio & Television Co., Ltd.—Winding up voluntarily. Liquidator, Mr. N. W. Osborne, 11-12, Finsbury Square, London, E.C.2, appointed 1st May.

Electrocone Products (Manchester), Ltd., electrical engineers.—Winding up voluntarily. Liquidator, Mr. L. R. Wilkinson, 79, Mosley Street, Manchester, 2, appointed 1st May.

Martin Electric (London), Ltd.—Winding up voluntarily. Liquidator, Mr. A. W. Hunter, Latham & Co., Walter House, 418-422, Strand, London, W.C.2, appointed 30th April.

Hornby Electrical Supplies Co., Ltd., and **Robert Hornby & Co., Ltd.**—In voluntary liquidation. Meetings of members on 17th June at Kelvin Works, Hackbridge, Surrey, to receive an account of the winding-up by the liquidator, Mr. J. J. S. Herd.

W. E. Partridge (Electrical), Ltd.—Winding up voluntarily. Liquidator, Mr. R. F. Bendall, 126, Colmore Row, Birmingham, 3.

Bankruptcies

L. L. O'Connor, electrical engineer (trading as Paragon Electrical), 27, Wellington Square, London, S.W.3.—Last day for receiving proofs for dividend 27th May. Trustee, Mr. A. A. Walter, Bankruptcy Buildings, Carey Street, London, W.C.2, Official Receiver.

F. W. Mason, trading as F. W. Mason & Son, at 20, Shamrock Avenue, Ipswich, Suffolk, electrical contractor and radio and television engineer.—Last day for receiving proofs for dividend to-day (Friday). Trustee, Mr. R. A. Paterson, Archdeacons House, Northgate Street, Ipswich.

G. L. Milton and **A. Coates,** formerly carrying on business in partnership as Electro Radio, at 44, High Street, Buxton, radio and electrical contractors.—Last day for receiving proofs for dividend to-day (Friday). Trustee, Mr. J. B. G. Moore, 20, Byrom Street, Manchester, 3, Official Receiver.

E. G. Phillips, electrical engineer, 39, Carrs Lane, Birmingham.—Trustee, Mr. R. F. Bendall, 126, Colmore Row, Birmingham, appointed 3rd May.

K. R. Clover, trading as K. R. Clover & Co., at 3, Market Cross, Sturminster Newton, Dorset, radio and electrical engineer.—First dividend of 5s 4d in the £, payable on and after 28th May at 50, The Terrace, Torquay.

R. Powell, lately carrying on business as an electrical goods retailer under the name of Domestic Electrics at 127, Newgate Lane, Mansfield, Notts.—Application for discharge to be heard on 28th June at the Court House, Brimington Road, Chesterfield.

G. H. Watts, lately carrying on business with another as Watts & Watts, at 185, Stockwell Road, Stockwell, London, S.W.9, and at 32, Moat Place, Stockwell, S.W.9, as electrical engineers.—Order made 5th April suspending discharge for one month. Bankrupt discharged as from 5th May.

C. Sykes, 10, High Kepplewray, Broughton-in-Furness, Lancs, electrician.—Last day for receiving proofs for dividend 29th May. Trustee, Mr. D. Atkinson, 14, Lowther Street, Carlisle, Official Receiver.

Molten Metal Holding Unit

Construction of the first "Birlec-Ajaxomatic" unit for holding molten aluminium and zinc alloys for supplying predetermined quantities of metal to diecasting machines has just been completed by Birlec, Ltd. Rated at 20 kW, the unit has an average power consumption of 10-12 kW, a useful molten capacity of 300 lb, and a maximum pouring rate of about 2 lb per second. The quantity of metal delivered per shot is adjustable between ½ lb and 10 lb.

The unit employs a coil supplied with a.c. from normal-frequency mains and is equipped with an iron core to concentrate the magnetic field. This field also passes through part of the furnace charge which acts, in effect, as a short-circuited secondary winding of a transformer, carrying a heavy induced current. In this way heat is generated within the charge and is not imparted to it from an outside source. The molten metal in the bath is thermostatically controlled at the required temperature. A standard refractory lining as used for aluminium melting is employed in the holding chamber.

The lid gear is effectively air sealed and compressed air, introduced above the melt, causes a quantity of molten metal to be forced up the pouring spout from a point below the surface. The quantity discharged in this manner can be accurately regulated by controlling the duration of the compressed air flow. Furthermore, an automatic device compensates for the difference in volume within the holding chamber caused by each successive shot.

The control panel is divided into two sections. The first contains the standard temperature regulators and furnace controls. The second, in addition to the timing controls which regulate the compressed air supply, contains an automatic device that controls a supply of heat to the pouring spout. This auxiliary supply is essential to prevent the molten metal from chilling during discharge.

Once the timing dials are set, the actuating button is pressed and the required quantity is automatically delivered from the spout in a gentle controlled stream which can be directed into the chamber of the diecasting machine.

Since the space above the melt is sealed by the close-fitting lid gear, special provision can be made for an inert atmosphere to be maintained in contact with the molten metal. By this feature the unit can also be employed for magnesium diecasting.

"Birlec-Ajaxomatic" unit

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) will be obtainable after 29th May from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1952

13587. National Research Development Corporation.—Computing devices. 28th May, 1953. (775974.)

17551. General Electric Co.—Electrically heated blankets. 11th July, 1952. (775653.)

24660. Simplex Electric Co., Ltd.—Dish-washing apparatus. 2nd October, 1953. (775975.)

33068. Stone & Co. (Deptford), Ltd., J.—Electromagnetic carbon-pile regulators. 18th December, 1953. (775541.)

1953

10031. Brush Electrical Engineering Co., Ltd.—Fusible elements for cartridge fuse-links for electrical circuits. 13th April, 1954. (775977.)

16668. Electric & Musical Industries, Ltd.—Television relay systems. 4th June, 1954. (775871.)

23581. British Insulated Callender's Cables, Ltd.—Joint for electric conductors. 25th August, 1954. (775557.)

29532. D.S. Plugs, Ltd.—Electric torches. 4th October, 1954. (775662.)

30792. Standard Telephones & Cables, Ltd.—Electric signalling systems employing continuously transmitted carrier or pilot current. 6th November, 1953. (775873.)

1954

3184. English Electric Co., Ltd.—Speed-sensitive electric regulators. 3rd May, 1955. (775563.)

3921. Littelfuse, Inc.—Electric fuses. 10th February, 1954. (775646.)

4447. Siemens & Halske Akt.-Ges.—Processes and apparatus for treating semi-conductor devices. 15th February, 1954. (775986.)

6527. British Thomson-Houston Co., Ltd.—Electronic control circuits. 3rd March, 1955. (775568.)

8140. Metropolitan-Vickers Electrical Co., Ltd.—Seals for electrical waveguides. 31st March, 1955. (775569.)

10551/2. General Electric Co., Ltd.—Automatic frequency control of electric oscillation generators. 6th April, 1955. (775572/3.)

11011/2. Foster Transformers, Ltd., and Jennings, R. E.—Voltage regulator devices. 13th April, 1955. (775741/2.)

13194. Electric & Musical Industries, Ltd.—Automatic gain control circuits for television receivers. 26th April, 1955. (775673.)

13731. General Electric Co., Ltd., Howarth, P., and Ryeroft, J. L.—Snap action mechanisms, particularly suitable for electric switches. 11th May, 1955. (775576.)

15017/8/9. British Thomson-Houston Co., Ltd.—Electrical circuit-breakers with automatic reclosing mechanism. 19th August, 1955. (775861/2/3.) 15021. Electrical circuit-breakers. 18th August, 1955. (775865.) 15023. Electrical circuit-breakers with automatic reclosing mechanism. 18th August, 1955. (775867.)

15262. British Dielectric Research, Ltd.—Manufacture of electric capacitors. 23rd May, 1955. (775842.)

15283. General Electric Co., Ltd.—Control of a.c. electric motors. 23rd May, 1955. (775674.)

17424. British Thomson-Houston Co., Ltd.—Electric connectors. 8th June, 1955. (775992.)

18331. Raytheon Manufacturing Co.—Travelling-wave electron tubes. 22nd June, 1954. (775994.)

18419. British Insulated Callender's Construction Co., Ltd.—Insulators for high voltage overhead electric power lines. 23rd September, 1955. (Cognate application 21796, 26th July, 1954.) (775773.)

20389/90/1. Milwaukee Gas Specialty Co.—Thermo-electric generator. 12th July, 1954. (775968/9/70.)

21154. Tinsley (Industrial Instruments), Ltd., Steghart, F. L. F., and Kershaw, P. L.—Transducers. 14th July, 1955. (775996.)

21795. British Insulated Callender's Cables, Ltd.—Enclosure for a line tap or other electric connecting device. 26th July, 1955. (775997.)

24315/6. British Dielectric Research, Ltd.—Manufacture of dielectric materials. 19th August, 1955. (775580/1.)

24895. Electric & Musical Industries, Ltd.—Circuits for generating high unidirectional voltages. 24th August, 1955. (776003.)

25286. General Electric Co.—Spark gap device. 31st August, 1954. (775583.)

25473. Standard Telephones & Cables, Ltd.—Switching circuits utilising electric-discharge tubes. 2nd September, 1954. (775584.)

25762. Stephens, F. W.—Electric circuit interrupters. 6th September, 1954. (776004.)

25234. Union Carbide & Carbon Corporation.—Impregnating carbon electrodes with drying oils and silver. 10th September, 1954. (775779.)

27834. Chilton Aircraft Co., Ltd.—Electrical circuit-breakers. 26th September, 1955. (775895.)

30124. Telefonaktiebolaget L. M. Ericsson.—Frequency or phase modulated signal transmission relay stations. 19th October, 1954. (775845.)

30502. Welwyn Electrical Laboratories, Ltd., and Whitfield, E. H.—Electric rotary switches. 22nd October, 1954. (775592.)

30649. Sola Electric Co.—Constant voltage apparatus. 25th October, 1954. (776008.)

31966. Bristol Co.—Cold junction temperature compensation in electrical temperature measuring networks. 4th November, 1954. (775593.)

32394. Svenska Turbinfabriks Aktiebolaget Ljungström.—Gas turbine power plant. 9th November, 1954. (775786.)

33320. General Electric Co.—Thermo-electric generators. 17th November, 1954. (775902.)

33559. Westinghouse Electric International Co.—Control devices responsive to the direction of flow of power in an a.c. circuit. 19th November, 1954. (775903.)

36238. Decca Record Co., Ltd.—Waveguides. 1st December, 1955. (776015.)

36876. Teledictor, Ltd. — Electrically actuated counting apparatus. 2nd December, 1955. (775596.)

1955

1544. General Electric Co. — Drive mechanisms for clothes washing machines. 18th January, 1955. (775705.)

2312. Etablissements Merlin & Gerin.—Means for loading the actuating springs of circuit-breakers. 26th January, 1955. (776025.)

2504. Radio Corporation of America.—Method of producing by electrostatic means a pattern for masking selected areas of a surface. 27th January, 1955. (775812.)

2991. Automatic Electric Laboratories, Inc.—Traffic supervisory arrangements in telephone systems. 1st February, 1955. (776026.)

3048. Allmanna Svenska Elektriska Aktiebolaget.—Gas cooled atomic reactor equipment. 2nd February, 1955. (775602.)

4518. General Electric Co.—Mass spectrometers. 15th February, 1955. (776029.)

5037. Standard Telephones & Cables, Ltd.—Circuit arrangement for magnetic two-condition devices. 21st February, 1955. (775847.)

5422. Western Electric Co., Inc.—Signal transmission circuits. 23rd February, 1955. (775918.)

8012. General Electric Co.—Envelope structures for electric-discharge devices. 18th March, 1955. (775610.)

8780. Philips Electrical Industries, Ltd.—Radio receiving circuit arrangements for ultra high frequency oscillations. 25th March, 1955. (775612.)

9281. Soc. Industrielle de Télécommande et de Télémecanique.—Electromagnetic relays for alternating voltages and sensitive to certain harmonics. 30th March, 1955. (775924.)

11051. Standard Telephones & Cables, Ltd. (Bell Telephone Manufacturing Co. Soc. Anon.).—Electrically controlled digit indicating device. 18th April, 1955. (775927.)

11568. Radio Corporation of America.—Colour television synchronising circuits. 21st April, 1955. (775931.)

13085. General Electric Co.—Electric cells and batteries with solid electrolyte. 5th May, 1955. (776037.)

13192. Western Electric Co., Inc.—Apparatus including electrical transmission networks, particularly for the artificial production of speech. 6th May, 1955. (775797.)

13286. Telefunken Ges.—Method for the production of crystal valves. 9th May, 1955. (775934.)

13922. General Electric Co.—Clothes-treating machines. 13th May, 1955. (775935.)

14172. Allmanna Svenska Elektriska Aktiebolaget.—Means for isolating valve groups in a power converter for high voltage d.c. 17th May, 1955. (775620.)

15070. Telefunken Ges.—Cooling systems for high power electron-discharge tubes. 25th May, 1955. (775800.)

15569. Philips Electrical Industries, Ltd.—Magnetic electron lens structures. 31st May, 1955. (775622.)

15696. Alladin Industries, Inc.—Wide range radio frequency tuner. 1st June, 1955. (775851.)

16589. International Business Machines Corporation.—Electronic storage device. 9th June, 1955. (775727.)

16789. Allis-Chalmers Manufacturing Co.—Circuit-breakers. 10th June, 1955. (775940.)

19418. Collins Radio Co.—Means for preventing ageing effects in piezo-electric crystals. 5th July, 1955. (775624.)

21571. Ranco, Inc.—Control apparatus for electrically operated equipment. 26th July, 1955. (775731.)

22364. Siemens-Schuckertwerke Akt.-Ges.—Apparatus for generating periodic rectangular voltage impulses having variable impulse ratios. 3rd August, 1955. (775827.)

22405. Westinghouse Electric International Co.—Electric switching systems. 4th August, 1955. (775627.)

23288. Standard Telephones & Cables, Ltd. (Bell Telephone Manufacturing Co., Soc. Anon.).—Automatic telecommunication exchange. 12th August, 1955. (775252.)

23405. Triggs, W. W. (Rosenthal-Isolatoren-Ges.).—Pin-type electric insulators. 15th August, 1955. (775408.)

23406. Electric Machinery Mfg. Co.—Electrostrictive capacitive relay circuit. 15th August, 1955. (775733.)

23472. Siemens-Schuckertwerke Akt.-Ges.—Outdoor high voltage electric insulators. 15th August, 1955. (775952.)

24006. Standard Telephones & Cables, Ltd.—Condenser loudspeaker for reproduction of the higher frequency bands in the audible range and in which a foil is applied to a perforated metal sheet. 19th August, 1955. (775854.)

[*Continued at foot of page* 987

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—State Electricity Commission, Queensland, Brisbane. 26th June. Four 150 kVA and two 100 kVA transformers. (E.S.B. 12164/57. Ten/25798.)*

Western Australian Government Tender Board. 9th July. Four 10,000 kVA transformers. (E.S.B. 10588/57. Ten/25763.)*

Ayr.—The County Council will shortly issue schedules for trunk road lighting. (See this issue.)

Belgian Congo.—Ministry of Colonies, Brussels. 19th June. 1,220 vehicle batteries. (E.S.B. 11389/57. Ten/25821.)*

Bideford.—Corporation. 11th June. Lighting fittings for slaughterhouse. (See this issue.)

Boldon.—U.D.C. 1st June. Extensions to lighting installations in 156 houses at Boldon Colliery and Whitburn. J. Edmundson, surveyor, Council Offices, East Boldon.

Burma.—Burma Purchase Board, Rangoon. 29th May. Ceiling fans. (E.S.B. 12432/57. Ten/25859.)*

Grimsby.—R.D.C. 12th June. Duplicate sewage pumps and sludge pump complete with motors, controls, etc. John H. Haiste & Partners, Council consulting engineers, Belmont House, 20, Wood Lane, Leeds, 6.

India.—Hindustan Steel, Private, Ltd., Rourkela, Orissa. 10th June. Power equipment and switchgear, including main circuit-breakers, transformers, h.v. lines, switch houses, etc. (E.S.B. 11496/57. Ten/25867.)*

Government of Madras Electricity Department. 2nd July. Transformers ranging from 2,000 to 5,000 kVA. (E.S.B. 12093/57. Ten/25833.)*

Damodar Valley Corporation. The date for receipt of tenders for control panels (*Electrical Review*, 12th April) has been extended to 3rd June. (See this issue.)

Ipswich.—Corporation. 17th June. Street lighting equipment. (See this issue.)

New Zealand.—G.P.O., Wellington. 5th June. Electrolytic condensers. (E.S.B. 12066/57. Ten/25791.)* 6th June. Conduit saddles. (E.S.B. 12062/57. Ten/25831.)* Main contact relays. (E.S.B. 12063/57. Ten/25832.)* 10th June. Cable sockets. (E.S.B. 12061/57. Ten/25804.)* Electric lampholders and plugs. (E.S.B. 12067/57. Ten/25803.)* 11th June. Connectors and terminal blocks. (E.S.B. 12064/57. Ten/25810.)* 12th June. Flat-pin sockets and tumbler switches. (E.S.B. 12068/57. Ten/25807.)*

Christchurch City Council Electricity Department. 11th June. 1,100 V cambric insulated cable. (E.S.B. 12216/57. Ten/25817.)*

Auckland Electric Power Board. 19th July. Four 16,667 kVA, 110/12·7 kV and two 50 MVA, 110/22 kV transformers. (E.S.B. 12165/57. Ten/25845.)*

South Africa.—Stores Department, South African Railways, Johannesburg. 5th June. Insulating main resistance tubing. (E.S.B. 11367/57. Ten/25782.)* 7th June. 250,000 cable hangers. (E.S.B. 12076/57. Ten/25830.)* 7th June. Two 3 kW and three 12 kW diesel alternator sets and switchboard. (E.S.B. 12073/57. Ten/25818.)* 14th June. Cable end boxes. (E.S.B. 12504/57. Ten/25897.)*

Johannesburg City Council. 3rd June. Protective current transformers. (E.S.B. 12695/57. Ten/25914.)*

Union Tender and Supplies Board, Pretoria. 6th June. Cable jointing sleeves, plugs and collars. (E.S.B. 11850/57. Ten/25825.)* Universal electrical meters. (E.S.B. 11882/57. Ten/25787.)* Radio monitor receivers and aerial couplers. (E.S.B. 11857/57. Ten/25826.)*

Durban City Council. 14th June. Twelve 500 MVA, 33,000 V outdoor oil circuit-breakers. (E.S.B. 11897/57. Ten/25808.)* 28th June. Transformers ranging from 25 kVA to 1,000 kVA. (E.S.B. 11898/57. Ten/25816.)*

Southend-on-Sea. — Corporation. 5th June. Electrical installation in Dowsett High School for Girls. (See this issue.)

Tangier.—Tangier Water and Electricity Board. 31st May. Armoured cables, accessories and bare electrolytic copper bars. (E.S.B. 12362/57. Ten/25877.)*

United States.—Rocky Reach Hydro-Electric Power Project. 31st May. 230 kV switchyard equipment and structures. (E.S.B. 12308/57. Ten/25898.)*

West Kent.—West Kent Main Sewerage Board. 24th June. Three transformers at sewerage purification works, Dartford. (See this issue.)

NEW PATENTS (*continued*)

24036. General Electric Co.—Electrical conductors insulated with polyesters. 19th August, 1955. (775082.)

24252. Mullard Radio Valve Co., Ltd.—Protective devices for electronic discharge tubes. 23rd August, 1955. (775253.)

25060. British Federal Welder & Machine Co., Ltd., and Tribe, T. F.—Terminal connectors for electric welding cables. 31st August, 1955. (775287.) 25061. Electric cables for welding. 31st August, 1955. (775288.)

25096. Standard Telephones & Cables, Ltd.—Articulated electrical waveguide construction. 1st September, 1955. (775254.)

26840. General Motors Corporation.—Electrostatic spray coating. 20th September, 1955. (775830.)

27201. Western Electric Co., Inc.—Picture communication systems. 23rd September, 1955. (775832.)

32198. General Electric Co., Ltd.—Audio-frequency transistor amplifiers. 10th November, 1955. (775633.)

35458. Lewus, A. J.—Single-phase induction motors. 9th December, 1955. (775636.)

36118. General Electric Co.—Leakage transformers. 16th December, 1955. (775640.)

37378. Chanabon, E.—Electric sockets or holders intended to be fixed against a wall. 30th December, 1955. (775739.)

1956

3439. Littelfuse, Inc.—Electric fuses. 10th February, 1954. (Divided out of 775646.) (775647.)

ORDERS PLACED

Durham.—County Education Committee. Electrical work in schools:—Peterlee, Acre Rigg Modern (£6,422).—Eastern and Home Counties Electrical Contractors, Great Yarmouth. Willington New Modern (£9,020).—Devereux Moodie and Co., Newcastle. Wolsingham Grammar (£1,571).—R. Robson, Willington. Wolsingham New Grammar/Technical (£11,256).—Williams Brothers (Electrical), Newcastle.

Ryton (Durham).—U.D.C. Rewiring of 112 houses at Hexham Old Road, Ryton. Surveyor, Council Offices, Ryton, Co. Durham.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Andover.—C.E. primary school, Longparish; H. S. Sawyer & Sons, architects, St. John's Rooms, Broadway, Winchester.

Bexhill.—Flats (19), Cooden Drive; Flitcroft Estates, Ltd., 22, Buckhurst Road.

Birtley (Co. Durham).—Office block and 200,000 sq ft extra production space; Catterpillar Tractor Co., Ltd.

Blackburn. — Science wing at Queen Elizabeth Grammar School (£60,000); William Livesey & Sons, Ltd., builders, Nova Scotia, Blackburn.

Bolton.—Factory and offices, Raikes Lane estate; Powell & Alport, architects, 88, Cathedral Road, Cardiff.

Boston (Lincs).—Flats (24), Trinity Road; borough architect.

Bournemouth.—Houses, flats and bungalows (346), Kinson; borough engineer, Town Hall.

Brighton.—Flats (47) at Albion Hill and improved accommodation at Downs Infants' School; borough surveyor.

Canterbury.—Second stage of technical college scheme; city engineer, Dane John.

Chatham. — C.E. church, Huntsman's Corner, Maidstone Road; A. B. Knapp-Fisher, architect, 9, Gower Street, London, W.C.1.

Chesterfield.—Library block for William Rhodes School; Wilcockson & Cutts, architects, 12, Saltergate.

Coventry.—Hostel (£42,000) for the Y.W.C.A.; local secretary, 16, Queen's Road.

Crawley.—Houses (87), Ifield; R. W. J. Tridgell, clerk, Robinson House, Robinson Road.

Croydon.—Archbishop Tenison Grammar School; Geo. Lowe, architect, 4, High Street.

Dartford.—Factory and offices; Craig & Rose, Ltd., 47/48, Bankside, London, S.E.1.

Dover.—Factory, Granville Street and Churchill Street; John Lawrence & Co. (Dover), Ltd., Charlton Green.

East Retford (Notts).—Houses (44), West Hill estate; K. D. Hanna, town clerk, Municipal Offices.

Gillingham (Kent).—Houses (39), Church Street, Christmas Street and Christmas Place; borough engineer, Municipal Buildings.

Grays.—Stage 2 of Thurrock Technical College; Whyatt (Bldrs.), Ltd. 225, Streatham High Road, London, S.W.16.

Grimsby.—Houses (50), Fairway estate, Waltham; L. P. Bradshaw, architect, 1, Deansgate Terrace.

Guildford.—Houses (108), Park Barn estate; Oliver R. Croudace, Ltd., builders, 97, Godstone Road, Caterham.

Guisborough.—Houses (302), Hutton Lane, for U.D.C.; P. R. Middleton, architect, 17, Albert Road, Middlesbrough.

Hale.—Flats (28), in seven blocks, Grove Lane; R. W. Horsfall, clerk to U.D.C., Council Offices, Hale, Cheshire.

Halesowen.—Multiple store, Peckingham Street; E. Woodbourne, company architect, F. W. Woolworth & Co., Ltd., 1, New Bond Street, London, W.1.

Hayes and Harlington.—Houses (62), Park Farm estate; surveyor, Town Hall, Hayes, Middlesex.

Hull.—Library building for the University; W. A. Forsyth & Partners, 47, Nottingham Place, London, W.1.

[*Continued on next page*

Ilford.—R.C. secondary school, Cameron Road; D. Plaskett Marshall, architect, 59, Gordon Square, London, W.C.1.

Kingston-on-Thames.—Fire station, Richmond Road/Tudor Drive corner site (£51,000); Surrey county architect, County Hall, Kingston-on-Thames.

Leeds.—Adaptations, etc., to Chapeltown Tram Depot to provide offices and stores for the Central Purchasing Department (£38,394); city architect, Priestley House, Quarry Hill, 9.

Letchworth (Herts). — Houses (280), Grange estate; surveyor, Council House.

Liverpool.—Office block, Old Hall Street; Quiggin & Gee, architects, 11, Old Hall Street.

London.—Three-storey block of flats, Lessar Avenue, Clapham, and four-storey block of flats, Brodrick Road, Tooting; R. H. Jerman, town clerk, Municipal Buildings, Wandsworth, S.W.18.

Adaptations to Grove Park Hospital, Lee (£54,000); Drower & Sons, surveyors, 28, Victoria Street, S.W.1.

Five-storey block of flats, Lawrie Park Gardens, Sydenham; S. M. Cleator, structural engineer, 4, Ridgmount Street, W.C.1.

Fifteen-storey block of flats, Church Street, Marylebone; Bridgwater & Shepheard, architects, 42, Bruton Place, W.1.

Malden and Coombe.—Mental deficiency centre, Blagdon Road/Burlington Road area; Surrey county architect, County Hall, Kingston-on-Thames.

Reading.—Houses (654) and five shops, Bulmershe estate; G. F. Darlow, town clerk, Town Hall.

Runcorn.—Conversions at Scala Cinema Theatre to form dance hall; William and Segar Owen, architects, Palmyra Square, Warrington.

Salford.—Eight-storey flats, King Street; city engineer, Town Hall, 3.

Slough.—Extensions to Town Hall (£300,000); Basil Spence & Partners, architects, 48, Queen Anne Street, London, W.1.

Somerset.—Secondary modern schools at Chard and Dulverton; R. O. Harris, county architect, Park Street, Taunton.

Stockton.—Houses (87), Hardwick estate; Moore & Cartwright, Stockton.

Sunderland.—Multi-storey flats (340), Whitburn and Barclay Streets area; H. C. Bishop, borough architect, Stockton Road.

New premises, Spelterworks Road; Sunderland Engineering Equipment Co., Ltd., Pallion, Sunderland.

Swansea.—Hotel, Castle Gardens; Jonah Arnold & Smith, architects, Great Western Chambers, Neath.

Waltham Abbey.—King Harold Secondary School; Woodroffe, Buchanan & Coulter, architects, 5, Bedford Row, London, W.C.1.

Catalogues and Lists

CONDUIT FITTINGS.—Leaflets on a new "Blaco" screwed conduit to flexible conduit adaptor and a dry partition wall switch or socket box.—**F. C. Blackwell & Co., Ltd.,** Great Crosby.

DOMESTIC APPLIANCES. — 20-page catalogue illustrated in colour, together with a separate price list, giving particulars of the company's range of electric cookers, wash boilers, fires, convectors and other appliances. —**Jackson Electric Stove Co., Ltd.,** Dallow Road, Luton, Beds.

FANS.—Leaflet giving particulars of "Turbro" p.v.c. ducting and the "Turbro-Cyclone" range of p.v.c. fans for chemical fumes, corrosive gases and laboratory ventilation.—**Turner & Brown, Ltd.,** Davenport Works, Bolton.

Descriptive list (V.1220) dealing with the Mark I propeller fans and a folder (V.3644) covering ancillary equipment for propeller fans.—**Woods of Colchester, Ltd.,** Braiswick Works, Colchester.

HEATING ELEMENTS.—Folder (2/956) dealing with a range of cartridge units for localised heating.—**Elmatic,** Colchester Factory Estate, Cardiff.

INDUCTION HEATING. — Loose-leaf booklet entitled "Radio Frequency Induction Heating Applications Bulletin."—**English Electric Co., Ltd.,** Kidsgrove, Stoke-on-Trent.

Leaflet describing the Model C9 1 kW induction heater recently introduced by the company.—**Radio Heaters, Ltd.,** Eastheath Avenue, Wokingham, Berks.

LIGHTING FITTINGS.—32-page illustrated catalogue together with a separate price list covering tungsten and fluorescent lighting fittings and luminous ceilings.—**Courtney, Pope (Electrical), Ltd.,** Amhurst Park Works, Tottenham, London, N.15.

Leaflet (114B) describing the company's "Brytal" aluminium and silvered glass reflectors.—**Clarke, Chapman & Co., Ltd.,** Victoria Works, Gateshead, Co. Durham.

Illustrated catalogue (5701) dealing with the "Holoflux" optical louvre system designed for the scientific control of tubular fluorescent light sources in commercial installations.—**Holophane, Ltd.,** Elverton Street, Westminster, London, S.W.1.

80-page illustrated catalogue covering the company's range of tungsten filament and fluorescent lighting fittings, etc., together with separate price list and index.—**Ekco-Ensign Electric, Ltd.,** 45, Essex Street, Strand, London, W.C.2.

Illustrated descriptive catalogue of the "Satina" range of opal glass pendant lighting fittings.—**A.E.I. Lamp & Lighting Co., Ltd.,** Crown House, Aldwych, London, W.C.2.

Pamphlet (P.5701) giving notes on the performance of the "Reflectortight" non-corrodible watertight fittings.—**Rowlands Electrical Accessories, Ltd.,** Hockley Hill, Birmingham, 18.

LOCK WASHERS.—Descriptive brochure on the "Palnut" safety lock washers for use on electrical plant and equipment.—**Palnut Co., Ltd.,** 28, Elder Row, Brighton, 1.

METALLURGICAL INSTRUMENTS. —8-page catalogue illustrating and describing an electrolytic polisher for metallographic specimens.—**Nash & Thompson, Ltd.,** Oakcroft Road, Chessington, Surrey.

METERS.—Descriptive catalogue (M.2m) illustrated in colour and describing three types of a.c. prepayment meters produced by the company.—**Ferranti, Ltd.,** Hollinwood, Lancs.

REFRIGERATORS.—Illustrated leaflet on the "International" 6 cu ft domestic refrigerator recently introduced by the company. —**Lec Refrigeration, Ltd.,** Shripney Works, Bognor Regis, Sussex.

SEMI-CONDUCTORS. — Booklet containing information including characteristics, curves and application notes on the complete range of Mullard germanium diodes and transistors.—**Mullard, Ltd.,** Mullard House, Torrington Place, London, W.C.1.

WHOLESALE SUPPLIES. — 258-page illustrated and priced catalogue dealing with the range of electrical equipment supplied by the company.—**F. Westerman (Wholesale), Ltd.,** 94, Dale End, Birmingham, 4.

Illustrated 256-page catalogue giving particulars and prices of industrial and domestic electrical apparatus available from the company.—**Ford Wholesale Electric, Ltd.,** 6, St. Leonards Road, Eastbourne.

WIRING ACCESSORIES.—40-page catalogue of insulated wiring accessories together with a separate price list.—**Nettle Electrical Accessories, Ltd.,** Harper Road, Wythenshawe, Manchester.

Descriptive 58-page catalogue, with thumb index, covering the company's range of wiring accessories and cables and flexibles, etc.— **Volex Electrical Products, Ltd.,** Salford, 6, Manchester.

Folder describing neon pilot-lamp units available in the "Gridswitch" range of switch assemblies and a leaflet dealing with twin 13 A switch-socket outlets.—**M.K. Electric, Ltd.,** Wakefield Street, London, N.18.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 1st June:—

SUPER ATOM. No. 762,343. Class 7. Portable electrically and pneumatically operated drilling and screw-driving machines and parts.—Desoutter Brothers, Ltd., 73, Baker Street, London, W.1.

SOLAR. No. 751,239. Class 9. Ceramic capacitors.—Solar Manufacturing Corporation, Los Angeles. Address for service, c/o F. J. Cleveland & Co., 29, Southampton Buildings, Chancery Lane, London, W.C.2.

GR (design). No. 751,943. Class 9. Electrical instruments and apparatus for measuring and testing electrical equipment.—General Radio Co., Cambridge, Mass., U.S.A. Address for service, c/o Frederick J. Cleveland, 329, High Holborn, London, W.C.1.

No. 756,629 (design). Class 9. Electrical apparatus and instruments, etc.—Bodenseewerk Perkin-Elmer U. Co., G.m.b.H., Ueberlingen/Bodensee, Germany. Address for service, c/o J. Longman, Jessel Chambers, 88-90, Chancery Lane, London, W.C.2.

MICROCARB. No. 756,169. Class 9. Electrical apparatus for measuring, recording and automatically controlling the transfer of carbon from the atmosphere to steel inside furnaces during the heat treatment of such steel.—Leeds & Northrup Co., Philadelphia, Penn., U.S.A. Address for service, c/o Mewburn Ellis & Co., 70-72, Chancery Lane, W.C.2.

MAG'GLO. No. 760,629. Class 9. Electrical apparatus and instruments and parts.—Barrie Raymond Robin, 90, Deacon Street, S.E.17.

TRIPENUATOR. No. 761,778. Class 9. Aerial coupling devices for radio and television receivers.—Eden Electric, Ltd., Charfleet Industrial Estate, Canvey Island, Essex.

MERLIN. No. 750,883. Class 11. Nuclear reactors and parts.—Associated Electrical Industries, Ltd., Crown House, Aldwych, London, W.C.2.

SAFARI. No. 762,385. Class 11. Electric hand lamps.—Mever Manufacturing Co., Ltd., Kowloon, Hong Kong. Address for service, c/o Cope & Co., 65, Victoria Street, S.W.1.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Sunday, 26th May, to Tuesday, 28th May

LLANDUDNO.—Electrical Contractors' Association. Annual Conference.

Tuesday, 28th May

LONDON.—Great George Street, Westminster, S.W.1, 5.30 p.m. Institution of Civil Engineers. "Portishead 'B' Power Station, with Particular Reference to the Circulating Water Works," by H. D. Morgan and Louis Sancha.

Manson House, Portland Place, W.1, 6 p.m. Society of Instrument Technology, London Meetings. Annual general meeting followed by an address by Sir Harold Hartley.

SANDMORE.—Sandmore Golf Course. I.E.E. North Midland Centre. Annual golf competition.

Wednesday, 29th May

DORCHESTER. — I.E.E. Southern Centre, 7 p.m. Visit to Post Office Radio Station.

GLASGOW.—At the Institution of Engineers and Shipbuilders, Elmbank Crescent, 7 p.m. I.E.E. Scottish Centre. Annual general meeting, followed by "The Allt-na-Lairige Prestressed Concrete Dam," by J. A. Banks.

HOVE.—New Imperial Hotel, First Avenue, 7.30 p.m. A.S.E.E. Brighton, Hove and Districts Branch. "Relays and Automatic Control in Industry," by Dr. W. L. Stern.

Wednesday, 29th May, to Saturday, 1st June

SWINDON.—Bath and West Show.